TM 11-5028

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

SHFG.
B-8

EMTO LIBRARY

AMPLIFIER ASSEMBLY AN/FRA-1A

DEPARTMENT OF THE ARMY • NOVEMBER 1948

TECHNICAL MANUAL

AMPLIFIER ASSEMBLY AN/FRA-1A AND AN/FRA-1B

CHANGES No. 1

DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *23 July 1951*

TM 11-5028, 10 November 1948, is changed as follows:

The title of the manual is changed to read:

AMPLIFIER ASSEMBLIES AN/FRA-1A and AN/FRA-1B

Add **"and Amplifier Assembly AN/FRA-1B"** after "Amplifier Assembly AN/FRA-1A" in the following places in the manual:

Page x. caption.
Page 1. Paragraph 1, line 3.
Page 1. Paragraph 6, line 3.
Page 2. Figure 1, caption.
Page 3. Figure 2, caption.
Page 4. Figure 3, caption.
Page 7. Paragraph 11, line 3.
Page 7. Paragraph 11*a*, line 4.
Page 11. Part Two, note, lines 3, 4, and 5.
Page 16. Paragraph 19*f*, note.
Page 35. Paragraph 21, line 7.
Page 53. Paragraph 32, title.
Page 55. Paragraph 33*b*, line 5.
Page 55. Paragraph 33*c*, line 2.
Page 56. Part Four, title.
Page 56. Paragraph 34, line 2.
Page 58. Paragraph 36*a*(6), line 17.
Page 83. Paragraph 1, line 1.
Page 85. Paragraph 2, title.

3. General

Amplifier Assembly AN/FRA-1A **and Amplifier Assembly AN/FRA-1B are** intended for fixed military radiotelegraph service as 6- to 10-kw (kilowatt) **amplifiers** used in conjunction with 350-watt, 150- to 550-kc (kilocycle) Radio Transmitter BC-365-( ) as exciter. TM 11-828, Radio Transmitter BC-365-F * * * (59° F. to 122° F.).

Note (Added). Official nomenclature followed by (*) is used to indicate all models of the item of equipment included in this technical manual.

4. Identification of Major Components

Amplifier Assembly AN/FRA-1A **and Amplifier Assembly AN/FRA-1B each** consists of an amplifier (fig. 1), a rectifier unit (fig. 2), and an antenna tuning unit (fig. 3). A kit of * * * is also supplied.

5. Brief Description

The **amplifiers** and the rectifier **units** of Amplifier Assembly AN/FRA-1A **and Amplifier Assembly AN/FRA-1B** are conventionally designed aluminum frame-and-panel structures of the same size and shape. The frames are * * * antenna tuning networks.

7. Differences in Models

a. A similar equipment * * * the two equipments.

b. (Added). Amplifier Assembly AN/FRA-1B differs from Amplifier Assembly AN/FRA-1A in that the B model has a supplementary tap on the plate transformer secondary windings to permit operation of the equipment at higher altitudes. The B model also has a large corona ring on antenna loading coil L402; this ring is not included on the A model. Time-delay relay K301 on the rectifier unit is electrically identical on the A and B models, but the physical appearance of the relay is not the same on the two models, nor are the relays mechanically interchangeable. The B model uses tube type 3B28 as the bias rectifier in place of tube type 866A/866 which is used in the A model. The conductors of the transmission line in the B model are spaced 5 inches from the center line. This spacing is 6 inches in the A model. Figure 4. *Note* (Added). The length of the spreader insulator on Amplifier Assembly AN/FRA-1B is 10½ inches.

8. Technical Characteristics

Characteristic	Description
Frequency range	**150 to 550 kc, continuously tunable**
* *	* * *
Transmission line--	Surge impedance 350 * * * outer wires grounded. **The conductors are spaced on 5-inch centers on Amplifier Assembly AN/FRA–1B.**
* *	* * *
Tube complement---	1 Tube—JAN–891R, Amplifier. 6 Tubes—JAN–575A, plate rectifiers. 2 Tubes—JAN–866A/866, bias rectifiers. *Note.* (Added). Tube type 3B28 is used in place of tube type JAN–866A/866 on Amplifier Assembly AN/FRA–1B.
* *	* * *

9.1. Tables of Components for Amplifier Assembly AN/FRA–1B
(Added)

a. MAJOR COMPONENTS.

Components	Dimensions (in.)			Weight (lb)
	Height	Width	Depth	
Amplifier (fig. 1).	76	60	36	1,650
Rectifier unit (fig. 2).	76	60	36	*1,700
Antenna tuning unit (fig. 3).	110	84	62	2,600

*Does not include three plate transformers.

b. MINOR COMPONENTS.

Components	Description
Transmission line kit (fig. 4).	Consists of spreader insulators, line support assemblies, ground rods, spools of wire, and sundry hardware; packed in bulk.
Running spare parts kit.	Consists of vacuum tubes, indicator lamps, and air filters.

Note. The above lists are for general information only. See appropriate publications for information pertaining to the requisition of spare parts.

10. Packaging Data

a. (Superseded). CASE DIMENSIONS AND WEIGHTS.

(1) *Amplifier Assembly AN/FRA–1A.*

Case No.	Dimensions (in.)			Weight (lb)
	Height	Width	Depth	
1	86	77	48	1,900
2	86	77	48	1,930
3	88	85	30	1,510
4	86	38	57	1,025
5	95	48	48	900
6	42	36	36	370
7	35	28	39	179
8	36	23	21	465
9	36	23	21	465
10	36	23	21	465
11	39	20	20	93
12	39	20	20	93
13	39	20	20	93
Total weight----------				9,488

(2) *Amplifier Assembly AN/FRA–1B.*

Case No.	Dimensions (in.)			Weight (lb)
	Height	Width	Depth	
1	86	77	48	1,900
2	86	77	48	1,930
3	88	85	30	1,510
4	86	38	57	1,025
5	95	48	48	900
6	36	23	21	465
7	36	23	21	465
8	36	23	21	465
9	29	20	20	93
10	39	20	20	93
Total weight----------				8,846

b. CASE CONTENTS.

Note (Superseded). This list is not complete; it gives the general contents of each case for Amplifier Assembly AN/FRA–1A. For Amplifier Assembly AN/FRA–1B, the general contents of each case are almost identical with the A model except that cases No. 6, 7, and 13 have been omitted. For the exact contents see the packing list attached to each case. For specific unpacking instructions see paragraph 17.

* * * * *

11. Auxiliary Material

The material described * * * with this equipment.

* * * * *

f. FEED-THROUGH INSULATOR FOR TRANSMITTER HOUSE. Means for bringing * * * horizontal center line. **The outer conductors on Amplifier Assembly AN/FRA–1B are spaced 5 inches on either side of the horizontal center line.** All three conductors * * * bare copperweld wire.

* * * * *

i. TOOLS. A fairly complete * * * are as follows:

* * * * *

(23) (Added) Soldering iron and solder.

* * * * *

12.1. Running Spare Parts for Amplifier Assembly AN/FRA–1B (Added)

The following spare parts are supplied with the B model:

1 tube type 891R.
1 tube type 3B28.
3 tubes type 575–A.
2 lamps, 120-volt 25-watt Mazda No. 25T10-/IF.
2 lamps, 120-volt 6-watt Mazda No. 6S6.
1 lamp, neon, 120-volt 1-watt Mazda No. NE30.
2 air cleaners 30⅜ inches high by 30⅜ inches wide by ¾-inch thick.
4 feet of fuse wire for F401.

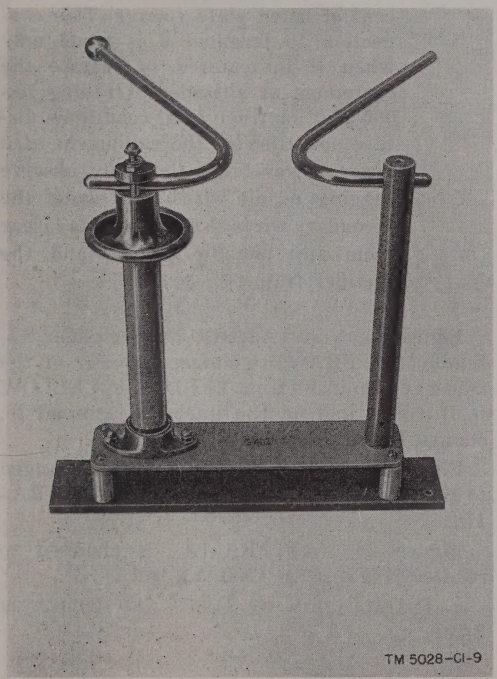


Figure 6.1 (Added). *Amplifier Assembly AN/FRA–1B, horn gap subassembly G402 for antenna tuning unit.*

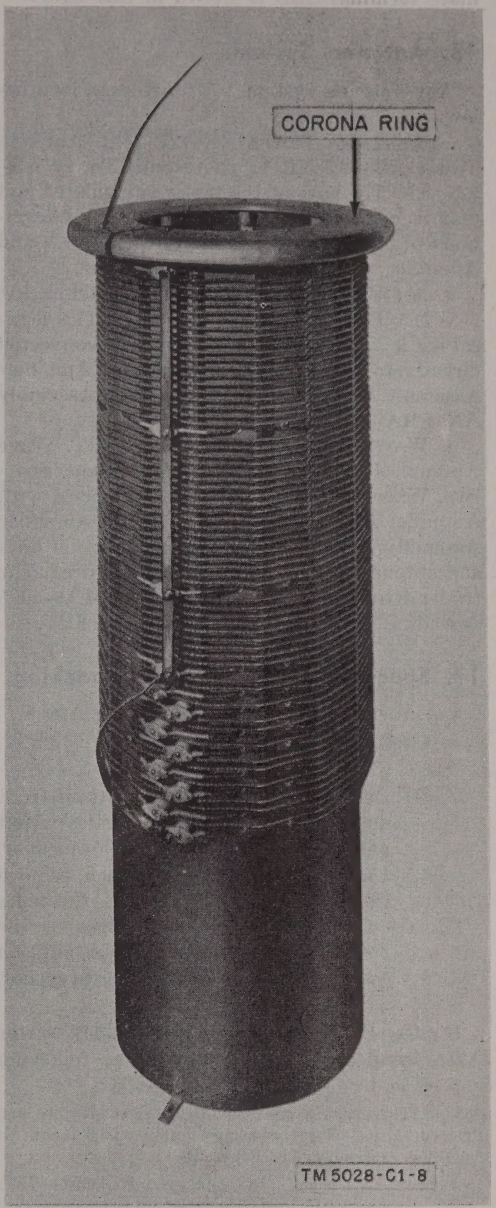


Figure 9.1 (Added). *Amplifier Assembly AN/FRA–1B, antenna loading coil L402, with corona ring attached, for antenna tuning unit.*

Figure 10. *Note* (Added). The plate transformer for Amplifier AN/FRA–1B has one more terminal than is shown in this figure.

13. Antenna Systems

Any antenna system * * * are described below.

a. ANTENNA TOWER AB–127–/FR. Antenna Tower AB–127/FR * * * Antenna Tower AB–127/FR. The base of the tower is insulated and may be connected directly to the antenna **terminals** of Amplifier Assembly AN/FRA–1A **and Amplifier Assembly AN/FRA–1B.**

b. ANTENNA KIT MX–765/FR. Antenna Kit MX–765/FR * * * five parallel wires. The vertical leg is a single wire which may be connected directly to the antenna **terminals** of Amplifier Assembly AN/FRA–1A **and Amplifier Assembly AN/FRA–1B.**

c. WAVE ANTENNA AS–334( )/FRT. Wave Antenna AS–334( )/FRT * * * 350 ohms resistive. When this antenna assembly is used with Amplifier Assembly AN/FRA–1A **and Amplifier Assembly AN/FRA–1B,** the transmission **lines** and antenna tuning **units** are not required. The transmitting end * * * at this time. **TM 11–5005 describes Wave Antenna AS–334( )/FRT.**

17. Specific Instructions on Unpacking

Note. For contents of cases see paragraph 10*b*.

a. CASE NO. 1.

* * * * *

(2) Remove the upper * * * bottom front door. Remove the short vertical front panels on both sides of the lower door.

(3) Using a **ratchet** socket wrench, remove the nuts and washers from the bolts on the front and back edges of the bottom shelf. There are four nuts on each side, spaced from corner to corner.

* * * * *

Figure 13. Add **"and AN/FRA–1B"** after AN/FRA–1A in the plan view. The following note is added:

Note. The spacing between the outer conductors and the center line of the transmission line is 5 inches in Amplifier Assembly AN/FRA–1B.

Figure 13. "80¾"" is changed to read—**76".**

19. Installation of Equipment in Transmitter House

a. PREPARATION OF UNDERFLOOR DUCT. Before moving the * * * duct as follows:

(1) Install a cable bushing in the duct 4 inches from the left-hand edge of the position determined for the rectifier. Figure 13 shows * * * of the rectifier.

(2) Install a cable bushing in the duct 4 inches from the right-hand edge of the position determined for the exciter.

* * * * *

e. INSTALLATION OF PLATE TRANSFORMERS.

Note. Before installing transformers * * * to ¼-inch spacing.

* * * * *

(4) Make connections to * * * be mixed up. Observe tagging. **On Amplifier Assembly AN/FRA–1B, the secondary wires come off three individual insulator posts. The connection is made to either terminal 6 or 7 on each transformer. Terminal 7 is the normal operating connection for the equipment. Terminal 6, however, represents a tap on the secondary winding, giving only 85 percent of rated plate voltage. This connection to terminal 6 is made only when it is required to operate the equipment at altitudes exceeding 10,000 feet, or when local conditions dictate operation of the equipment at a lower power level. Carefully observe tagging of all wires, and dress the secondary wires so that they stay clear from any metallic objects and the rectifier frame.**

* * * * *

Figure 21. *Note* (Added). For Amplifier Assembly AN/FRA–1B, change the color of the tracer of terminal 9 from YELLOW & YELLOW to BROWN, and for the tracer to terminal 20, change BLACK to BROWN & BLACK.

Figure 22. "FROM AN/FRA–1A" is changed to read: FROM AN/FRA–1A **AND AN/FRA–1B.**

Figure 23. "AN/FRA–1A" is changed to read—AN/FRA–1A **AND AN/FRA–1B.**

h. INSTALLATION OF TUBES AND INDICATOR LAMPS.

* * * * *

(3) Open the upper * * * in the rectifier. **Tube type 3B28 is used in place of tube**

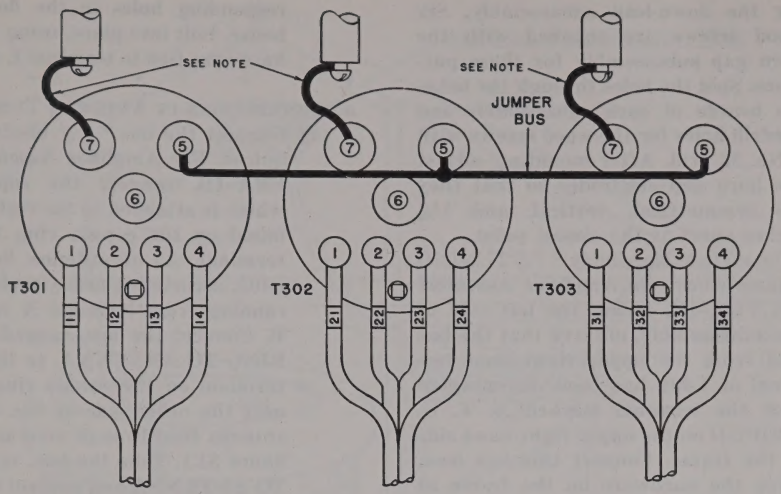


Figure 17.1 (Added). *Amplifier Assembly AN/FRA–1B, connections to plate transformers.*

type JAN–866A/866 in Amplifier Assembly AN/FRA–1B.

* * * * *

Figure 25. *Note* (Added). Amplifier Assembly AN/FRA–1B, tube type 3B28 is used in place of tube type 866A/866.

* * * * *

k. OPERATION FROM 50-CYCLE POWER. (Superseded)

(1) The coil of plate relay K–305 in Amplifier Assembly AN/FRA–1A (behind lower door on rectifier, left side) is designed for *60-cycle operation only.* If the power source is 50-cycle, this coil *must* be replaced by a special 50-cycle coil, which can be found in the running spare parts kit.

(2) Coil K305 in Amplifier Assembly AN/-FRA–1B may be used for both 50- and 60-cycle power.

20. Installation of Antenna Tuning Unit

Refer to figure * * * hardware is used.

a. PREPARATION OF SITE. **Clear** an area 9 feet by 7 feet adjacent to the antenna down lead. The 9-foot dimension * * * the plot level.

* * * * *

c. ERECTING HOUSE (fig. 30).

* * * * *

(3) Erect a side * * * was just erected. **Apply a ⅜-inch ID flat washer and a ⅜"–16 hexagonal nut to each of the carriage bolts and hand-tighten them.**

* * * * *

In figure 28, "⅜" I.D. FLAT WASHER—16 REQ'D" under ASSEMBLY HARDWARE is changed to read—⅜" I.D. FLAT WASHER—23 REQ'D. The following line is added: ⅜" x 4½" LAG SCREW–7 REQ'D.

(15) Referring to figure * * * of the house. **Note that the two front gussets are different from each other and from the two rear gussets (fig. 31).** Use the cross-pins * * * the nuts securely.

* * * * *

(18) Referring to figure * * * the closest point. **Referring to figure 34.1, install the horn gap subassembly, G402, and the ground down-lead subassembly on the inside back wall of the house. The horn gap subassembly is mounted horizontally across two vertical studs. The ground lead is fastened along the vertical member, as shown on figure 34.1. Use two wood screws for the horn gap subassembly and three wood screws**

for the down-lead subassembly. Six wood screws are supplied with the horn gap subassembly for these purposes. Spot the holes through the bakelite boards of each subassembly and predrill holes for the wood screws with a No. 35 drill. After mounting, adjust the horn gap electrodes so that they are symmetrical, vertical, and 1½ inches apart at the closest point.

(19) The main subassembly * * * TUNING control wheel. On Amplifier Assembly AN/FRA–1B, facing the left side of the subassembly, observe that the bus lead from the upper right-hand terminal of L401 has been disconnected from the terminal marked A. T. U. GROUND on the upper right-hand side of the frame. Connect this bus lead, using the hardware on the frame at the A. T. U. GROUND terminal. See figure 62 for the final appearance of this connection.

(20) The antenna loading * * * of the coil. On Amplifier Assembly AN/FRA–1B, coil L402 is to be assembled together with the corona ring as shown in figure 9.1. In shipment, however, the coil and ring are disassembled and packed in separate shipping containers. Take the loading coil and place it so that the row of terminals faces front, with terminal A on top and terminal L on bottom, as shown on figure 42. Take the corona ring and place it on top of the loading coil in such a way that the slot on the ring is just a few degrees to the left of the terminal row, as seen when facing the coil. Shift the ring slowly back and forth until the seven mounting holes line up with the ceramic posts located inside the coil around the inner circumference. Use the hardware supplied with the corona ring and mount the ring to the coil, applying a flat washer and a lockwasher under each mounting screw. Lift the complete antenna loading coil assembly and slide it through the opening behind the left front door (fig. 33). Maneuver the coil, with the terminals facing front, until the holes in the three mounting brackets at the bottom of the coil coincide with corresponding holes in the floor or the house. Bolt into place, using the bag of hardware tied to terminal L of the coil.

* * * * *

d. CONNECTIONS IN ANTENNA TUNING UNIT.

(1) Connect the bus * * * electrode if required. For Amplifier Assembly AN/FRA–1B, connect the copper strap which is attached to the right-side terminal on the corona ring to the top terminal, A, of antenna loading coil L402, securing it firmly under the link running from terminal A to terminal B. Connect the bus, tagged CORONA RING TO ANTENNA, to the left-side terminal on the corona ring and connect the other side of the bus to the antenna feedthrough stud as shown on figure 34.1. Take the bus, tagged G402 TO ANTENNA and connect it from the insulated electrode of horn gap assembly G402 to the antenna feedthrough stud. A stud on the outer end of the electrode mounting is provided for this purpose and is marked CONNECT TO ANTENNA. Tighten all screws securely. Check that the horn gap spacing is 1½ inches between the closest points, and readjust if required. Normal horn gap spacing is 50 percent above that at which breakdown occurs when the set is operating at its authorized output power.

(2) Connect a piece * * * transmission line kit. For Amplifier Assembly AN/FRA–1B, the ground connection from the ground electrode of the horn gap subassembly to the ground terminal of the main subassembly is made as shown on figure 34.1. Note that the No. 6 copperweld wire is routed along three standoff insulators and is not stapled directly to the wooden stud. Tin the copperweld wire on both ends to provide for good electrical connection. Dress the wire carefully so that it stays well away from the hot electrode of the horn gap subassembly.

* * * * *

Figure 33. *Note* (Added). Amplifier Assembly AN/FRA–1B includes a corona ring which is not shown in this figure. The corona ring is shown in figures 34.1 and 67.

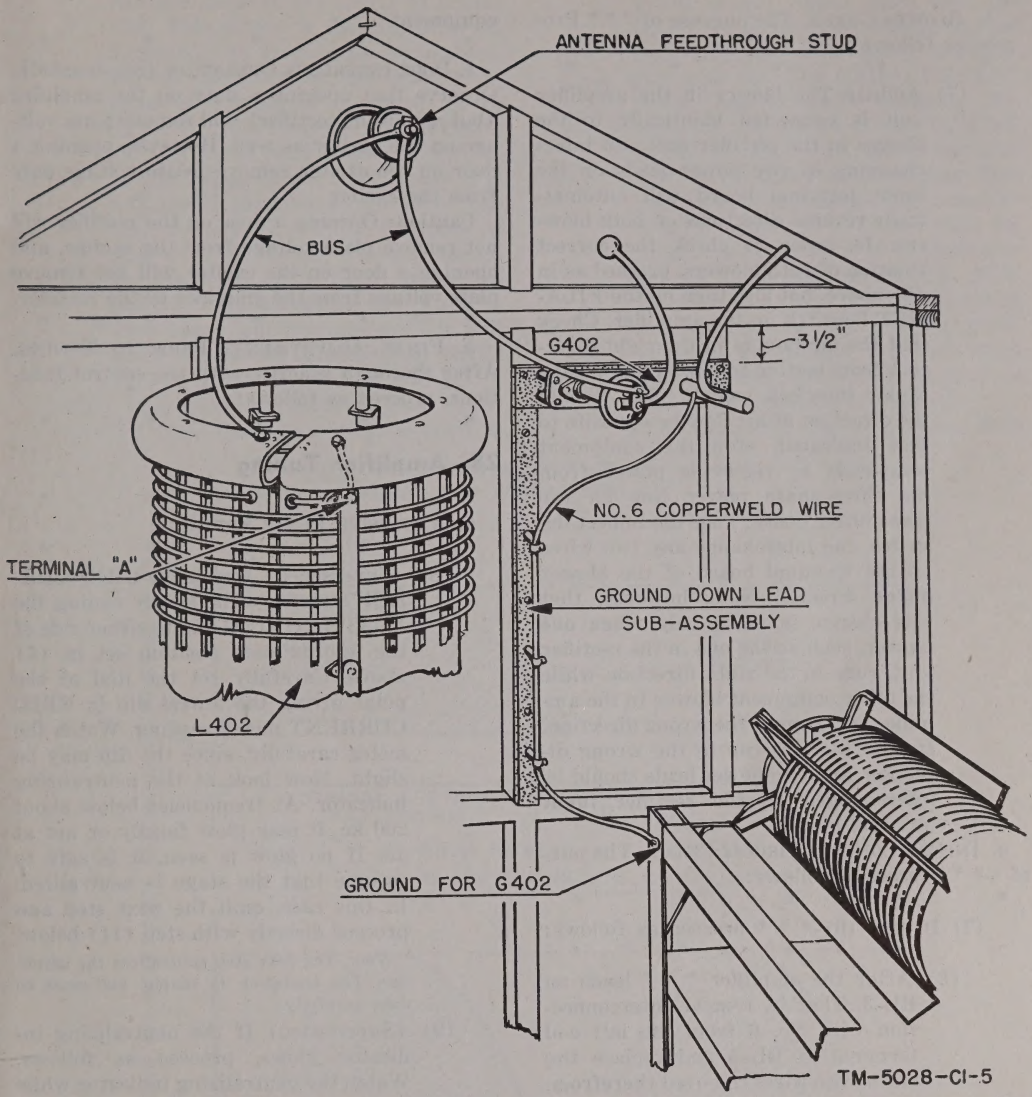


Figure 34.1 (Added). *Amplifier Assembly AN/FRA–1B, connections to antenna feedthrough stud, antenna loading coil, and horn gap.*

In figure 37, "$9\frac{1}{16}$" is changed to read—**$9\frac{5}{16}$".**

In figure 38, add **"and AN/FRA–1B"** after AN/FRA–1A.

In figure 40, identification markings are added as follows:

1. The left side of the figure is identified as **"RECTIFIER."**
2. The right side of the figure is identified as **"AMPLIFIER."**

25. Preliminary Adjustments

Note. All panels should * * * except as directed.

* * * * *

b. BLOWER CHECK. The purpose of * * * Proceed as follows:

* * * * *

(7) Added) The blower in the amplifier unit is connected identically to the blower in the rectifier unit and interchanging of two power leads on the input terminal board will automatically reverse directions on both blowers. In order to check the correct rotation of both blowers, proceed as in (5) above, but also turn on the FILAMENT switch on the amplifier. Check that the air flow is in the right direction from bottom to top, lifting paddle of air interlock switch S208. Should the direction of air flow be opposite to that indicated, stop the equipment completely by removing power from the three-phase power line on the transmitter house. Then disconnect the switch and interchange any two wires on the terminal board of the blower motor directly. Note, however, that this change is made only when one blower, such as the one in the rectifier unit, runs in the right direction while the other equipment blower in the amplifier unit runs in the wrong direction. If both blowers run in the wrong direction, any two power leads should be interchanged on the rectifier input terminal board.

c. INITIAL CONTROL CIRCUIT CHECK. The pur- of * * * Proceed as follows:

* * * * *

(7) If step (6) * * * proceed as follows:

* * * * *

(*b*) After the amplifier * * * leads on RL–3. That is, remove interconnection wire No. 6 from the left coil terminal of RL–3 and replace the one or two wires removed **therefrom.** Disconnect the one or two wires from the right coil terminal of RL–3, connect wire No. 6 thereto, and tape up the wire or **wires** removed (if two, connect together before taping). Reconnect power and close the door.

26. Practice with Control Circuit

After the preliminary * * * operating the equipment.

* * * * *

e. DOOR INTERLOCK OPERATION (Superseded). Observe that opening a door on the amplifier (but not on the rectifier) will remove plate voltage on the exciter as well. However, opening a door on the exciter removes plate voltage only from the exciter.

Caution: Opening a door on the rectifier will not remove plate voltage from the exciter, and opening a door on the exciter will not remove plate voltage from the amplifier or the rectifier.

* * * * *

h. FINAL ADJUSTMENTS PRIOR TO TUNING. After **thorough** practice with the control functions, proceed as follows:

* * * * *

28. Amplifier Tuning

* * * * *

b. AMPLIFIER PLATE SETTINGS.

* * * * *

(8) (Superseded) Watch the GRID CURRENT meter while slowly tuning the PLATE TUNING dial to either side of the approximate position set in (5) above. Carefully set the dial at the point giving the lowest dip in GRID CURRENT meter reading. Watch the meter carefully, since the dip may be slight. Now look at the neutralizing indicator. At frequencies below about 200 kc, it may glow faintly or not at all. If no glow is seen, it is safe to assume that the stage is neutralized. In this case, omit the next step and proceed directly with step (11) below.

Note. The next step neutralizes the amplifier. The operation is simple, but must be done carefully.

(9) (Superseded) If the neutralizing indicator glows, proceed as follows. Watch the neutralizing indicator while slowly tuning the GRID TUNING dial to either side of the position set in (5) above. At frequencies below 200 kc, the neutralizing indicator will glow brightly and then dim or go out completely as the GRID TUNING dial approaches zero. If it approaches 100, the indicator will go out and then either will stay out or glow dimly. The region of complete darkness may cover

half the range of the GRID TUNING dial. This action is illustrated in A, figure 47. At frequencies well above 200 kc, there will be two definite regions of brightness as shown in B, figure 47. Note that the original GRID TUNING dial setting always will be in the region toward the lower dial settings if the tuning procedure has been followed correctly. The pattern shown in A, figure 47, will merge gradually into B, figure 47, as the frequency is raised above 200 kc. The dark space will decrease until it will cover only about three or four GRID TUNING dial divisions at 550 kc.

(10) (Superseded) Restore the GRID TUNING dial to its original position found in (5) above. Now turn the GRID TUNING dial slowly toward 100 until the neutralizing indicator just goes out. The GRID CURRENT meter reading will decrease. Reresonate the exciter ANT. TUNING A dial to restore maximum amplifier GRID CURRENT meter reading. This may cause the neutralizing indicator to glow again; if it does, repeat the procedure above until it is possible to get maximum amplifier GRID CURRENT meter reading without causing the neutralizing indicator to glow. (Several repetitions may be necessary.) Neutralization is complete when this condition is restored.

Warning: In the next steps, plate

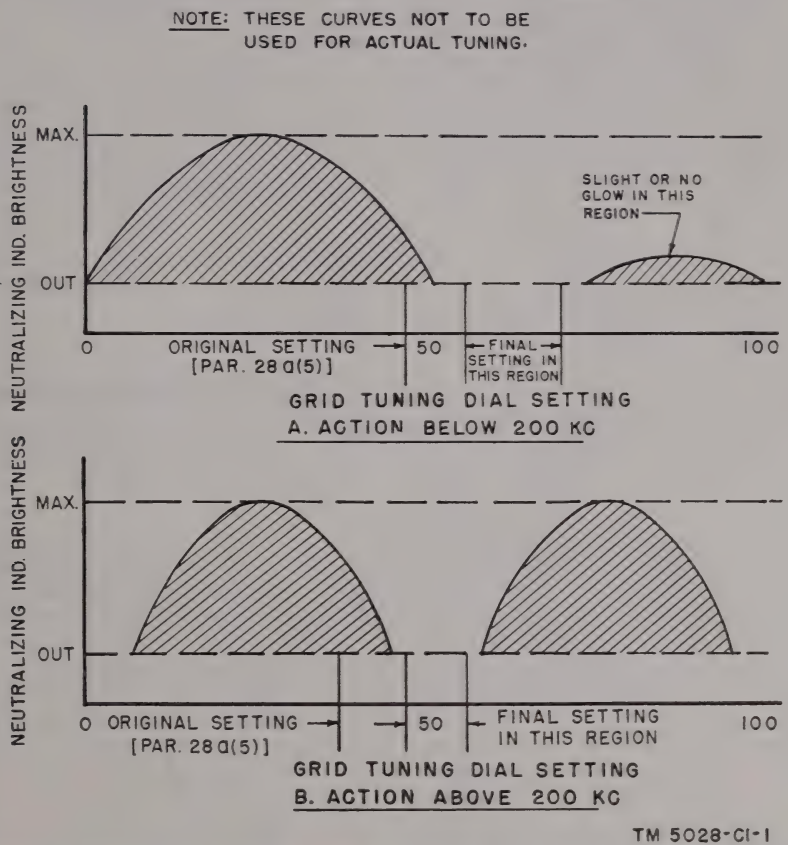


Figure 47 (Superseded). *Amplifier Assembly AN/FRA-1(*), action of neutralizing indicator.*

voltage is applied to the amplifier for the first time. Stop the equipment by opening the exciter PLATE switch, upper door on amplifier, and rectifier PRI. VOLTAGE ADJ. switch in that order. Use ground hook first if working inside equipment. Start equipment by reversing above procedure.

* * * * *

29. Antenna Tuning Unit Tuning

Warning: Keep personnel away * * * the control panel. **When full power is applied to the antenna tuning unit, the vicinity around the antenna tuning unit house is highly charged by a strong electrostatic field. This field is strongest near antenna loading coil L402. The strength of this field depends on atmospheric conditions and the power and frequency of operation; it may become strong enough to cause injury to personnel touching any metal parts on the antenna tuning unit, or carrying metallic objects such as pliers or screw drivers in their pockets. Do not approach the antenna tuning unit unless the r-f power from the exciter is turned off.**

* * * * *

b. METHOD WITH UNKOWN ANTENNA CHARACTERISTICS.

* * * * *

(2) Set R. F. LINE AMMETER and ANT. CURRENT AMMETER switches on **amplifier** and antenna tuning unit to READ position.

* * * * *

(4) (Superseded) In this condition, the antenna circuits probably will be badly out of tune. This means that the amplifier circuit will be loaded improperly and the amplifier PLATE CURRENT meter reading will be too high. To limit this, reduce the excitation to the amplifier as follows: Set the TUNE-OPERATE switch on the exciter to the TUNE position. Detune exciter intermediate power amplifier tuning dial as far as possible. Now start the equipment. Amplifier PLATE CURRENT meter reading will be zero or nearly zero because of lack of excitation. Slowly retune exciter intermediate power amplifier tuning dial. Amplifier PLATE CURRENT and R. F. LINE CURRENT meter readings will both rise. Continue tuning until amplifier PLATE CURRENT meter reads .75 ampere or until R. F. LINE CURRENT meter reads 7 amperes, whichever happens first. If these values cannot be reached, detune exciter intermediate power amplifier tuning dial and throw exciter TUNE-OPERATE switch to the OPERATE position, then retune intermediate power amplifier as instructed above.

* * * * *

(7) When antenna resonance * * * CURRENT will occur. If the **R. F. LINE CURRENT** goes to zero, increase the excitation by bringing the exciter ANT. TUNING A dial closer to resonance, so that enough R. F. LINE CURRENT is obtained for a clearly defined dip.

* * * * *

(14) When the R. F. LINE CURRENT maximum at 3 amperes has been reached, stop the equipment and set the amplifier PLATE **VOLTAGE** switch to HIGH position. Full plate voltage * * * now be available.

* * * * *

d. TYPICAL TUNING DATA. Typical tuning data * * * in table II. The antenna tuning * * * and 9 ohms.

* * * * *

31. Unusual Temperature or Altitude

The equipment is * * * as described below.

* * * * *

b. ABOVE 50° C. (122° F.).

* * * * *

(2) Operation above 65° * * * the rectifier tubes. **Should this situation become imminent, reduce the plate voltage further, as described in step (3) below.**

(3) (Added) If the equipment has to be operated at an altitude in excess of 10,000 feet, take precautions to prevent break-down of the equipment due to high-voltage flash-overs. To prevent arcing, reduce the high voltages to a permissible value. For this purpose, taps on the secondary windings on plate transformers T301, T302, and T303 have been provided on Amplifier

Assembly AN/FRA–1B. Reference to figure 17.1 shows the terminal arrangement of the plate transformers. The normal operating connection at which full plate voltage is obtained on each transformer is between terminals 5 and 7. Reduced plate voltage at 85 percent of normal value is obtained between terminals 5 and 6. In order to operate the equipment under reduced output conditions, locate the three transformer secondary connection leads coming from the insulator posts located adjacent to each transformer and connect them to terminal 6 on each of the three transformers. Note, however, that with a plate voltage that is 85 percent of normal, the power output is reduced to 70 percent of its normal value. To further reduce the plate voltage on the equipment, PLATE VOLTAGE switch S305 on the rectifier should be set to LOW position. This change further reduces the plate voltage by changing the primary connections of the transformers from a *delta* (high-voltage) to a *wye* (low-voltage) connection.

33. Weatherproofing

* * * * *

c. ARCTIC OPERATION. Amplifier Assembly AN/FRA–1A will perform satisfactorily under low **temperature** operating conditions; however, in placing this equipment in use at low temperatures, always allow the maximum possible warm-up time prior to operation. If possible, the * * * see paragraph 31.

35. General

Amplifier Assembly AN/FRA–1A **and Amplifier Assembly AN/FRA–1B are r-f amplifiers** designed to be excited from Radio Transmitter BC–365–( ). **Each** provides 6 to 10 kw of power output into an antenna system having 750 to 3,000 mmf capacity and 6 to 12 ohms resistance over the range 150 to 550 kc. The emission is * * * at the installation.

36. Radio-Frequency Circuits

(figs. 50, 63, and 64)

a. BASIC CIRCUIT (fig. 50).

* * * * *

(3) In the OPERATE * * * L–12 to ground. At the same time, the **amplifier** grid tank consisting of variometer L–201 and tank capacitors C–201 through C–203 and C–227 is connected to C–228. When the grid * * * the specified antenna.

* * * * *

b. DETAILS (fig. 64).

* * * * *

(6) (Added) Capacitors C221, C222, C236 and C237 are filament r-f bypasses for tube V201. Capacitor C231 bypasses the secondary center tap of transformer T204 for rf. Capacitors C234 and C235 bypass rf to ground at the meter. Capacitors C234, C235, C236, and C237 (.047 μf each) have been added to Amplifier Assembly AN/FRA–1B for additional r-f bypassing.

37. Power Circuits

a. PLATE VOLTAGE RECTIFIER (fig. 65).

* * * * *

(5) Plate primary voltage * * * to "delta" (high).

(5.1) (Added) On Amplifier Assembly AN/FRA–1B, the plate transformer secondary windings are provided with taps giving only 85 percent of the full secondary output voltage. These reduced voltage taps are used when the equipment is to be operated at altitudes above 10,000 feet in order to prevent insulation breakdown and arcovers.

* * * * *

b. BIAS VOLTAGE RECTIFIER (fig. 64).

(1) The bias rectifier * * * (Tube JAN–866A/866). **Amplifier Assembly AN/FRA–1B, uses tube type 3B28 instead of tube type 866A/866.** V–202 and V–203 * * * remove plate voltage.

* * * * *

38. Control Circuits

a. STARTING.

* * * * *

(2) Assuming a fresh start and when all the above switches are closed, blower delayed-release relay K–203 will close through the normally closed contact of blower **delay-release** timer K–205 and blower B–201 will operate. At the same * * * B–201 will stop.

* * * * *

(7) Closing of amplifier * * * BIAS breaker S–202. After 45 seconds, K–304 closes and energizes bias rectifier plate relay K–206 through door interlock switches S–311, S–307, S217, and S–218. In turn, primary * * * dropping resistor R–219).

* * * * *

39. Miscellaneous Protection

(figs. 63, 63.1, 64, 64.1, 65 and 65.1)

High-voltage points * * * R–329 through R–331.

Warning (Added): There is no interlock protection between the antenna tuning unit and the rest of the equipment. No work should be undertaken on the antenna tuning unit until the r-f power from the exciter has been removed.

42. Stripping

Most of the * * * in this paragraph.

a. BIAS RECTIFIER (figs. 52 and 53). All of the bias rectifier components, except bias rectifier tubes **V202 and V203** and BIAS switch S–202, are located on a subchassis in the lower left-hand corner of the amplifier unit. To remove the * * * subchassis is unnecessary.

* * * * *

44. Sectionalizing Trouble

Most troubles in * * * the transmitter house.

* * * * *

d. ANTENNA TUNING UNIT. If ANTENNA CURRENT * * * in the amplifier.

Warning (Added): If it becomes necessary to check the inside of the antenna tuning unit for purposes of inspection, adjustment, or replacement of fuse F401, make sure that the r-f power from the exciter is turned off before approaching or entering the antenna tuning unit house. While working in the antenna tuning unit house, use a ground hook before touching any part, and after making sure that no dangerous potential exists, place the ground hook on the center conductor of the transmission line on the outside of the antenna tuning unit house. Grounding the center conductor of the transmission line will prevent r-f power from being delivered to the antenna tuning unit if someone accidentally should turn on the exciter. Disconnect the ground hook from the transmission line when the repair is completed.

* * * * *

45. Localizing Trouble

After sectionalizing the * * * more obscure faults.

a. CONTROL CIRCUITS.

Symptom	Probable cause
* *	* * *
Filaments and blowers start, but there is no plate voltage; K–305 fails to close.	(1) K–304 motor defective.
	(2) K–201 fails to close because of defective tube **V202** and/or **V203.**
	(3) Door interlock open.
	(4) R–210 or R–335 out of equipment.
	(5) T–201 or T–202 defective.
* *	* * *

* * * * *

Figure 59. *Note* (Added). On the Amplifier Assembly AN/FRA–1B model, time-delay relay K301 is a mechanically different unit than that shown here and it is not physically interchangeable directly with relay K301 on Amplifier Assembly AN/FRA–1A. The electrical function of relay K301 on both models, however, is identical.

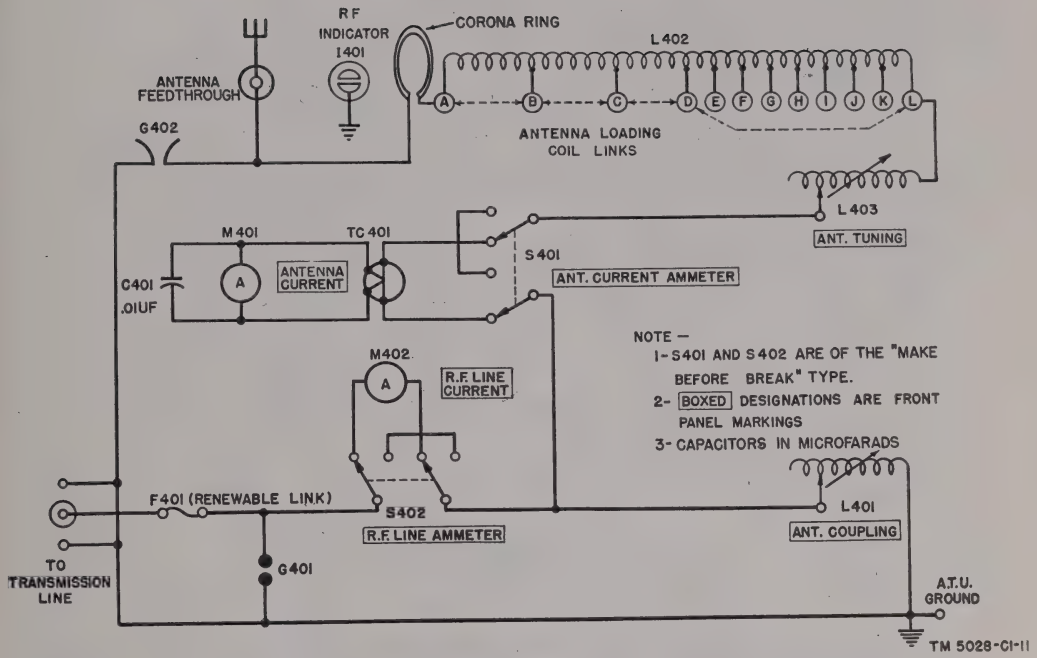
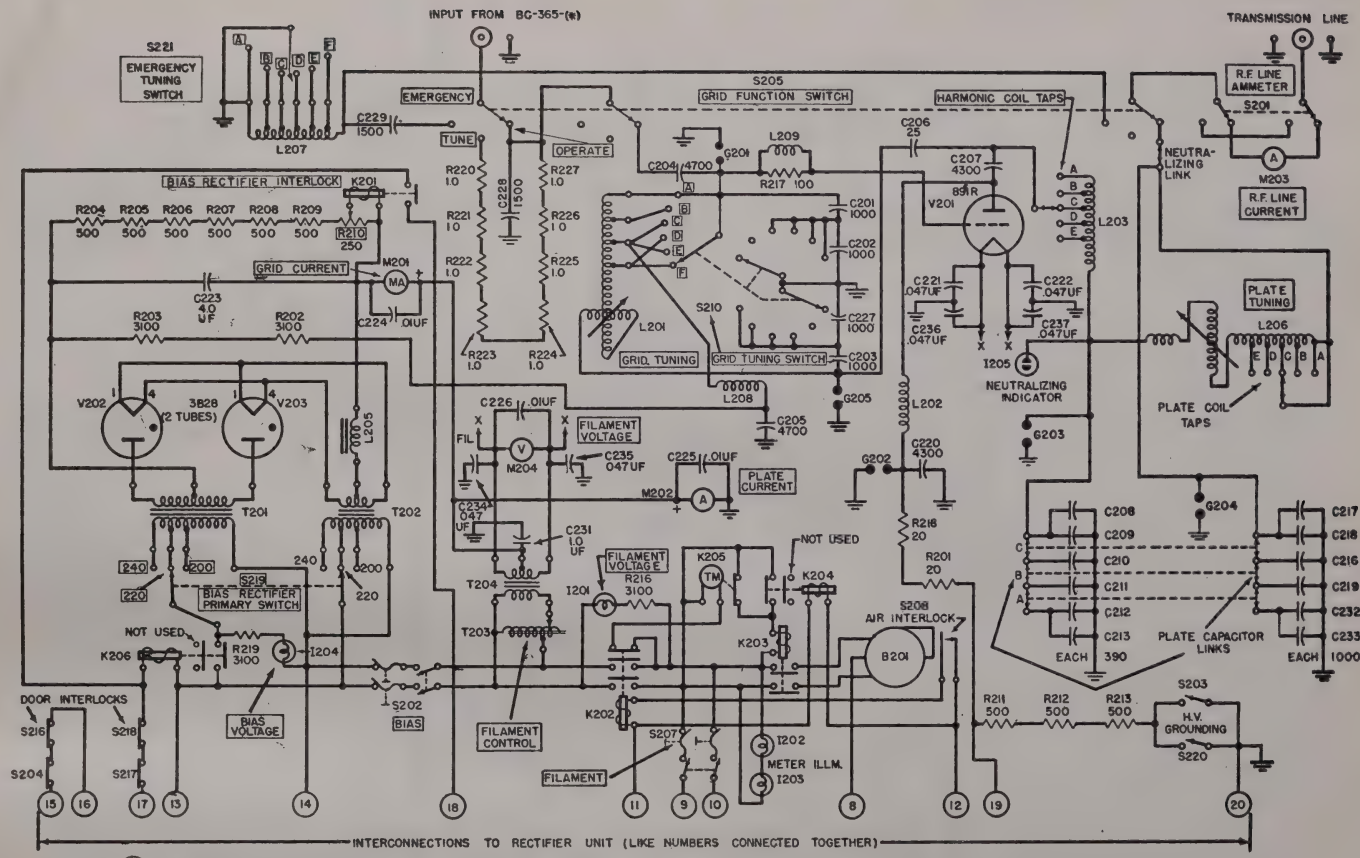


Figure 63.1 (Added). *Amplifier Assembly AN/FRA–1B, antenna tuning unit, schematic diagram.*



NOTES: (TM) = TIMER MOTOR
ALL RELAYS SHOWN UNENERGIZED.
S201-BOTH POLES ARE "MAKE BEFORE BREAK" TYPE
BOXED DESIGNATIONS ARE PANEL MARKINGS.
RESISTORS IN OHMS, CAPACITORS IN MICROMICROFARADS, UNLESS OTHERWISE SHOWN.
THE OPERATION OF S204, S217 & S220 ARE MECHANICALLY INTERLINKED AS ARE S216, S218 & S203.

TM 5028-C1-10

Figure 64.1 (Added). *Amplifier Assembly AN/FRA-1B, schematic diagram of power amplifier.*

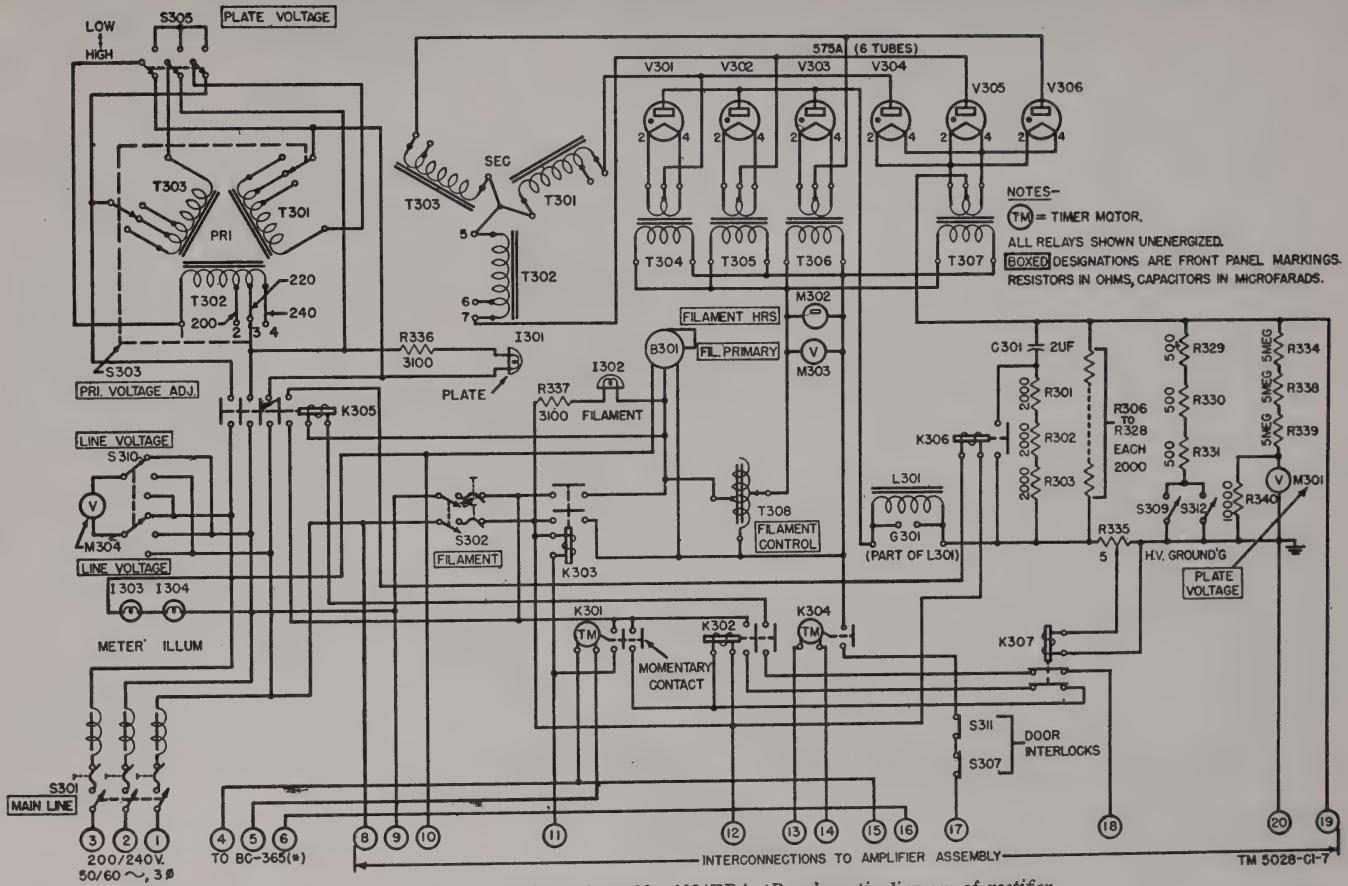


Figure 65.1 (Added). *Amplifier Assembly AN/FRA-1B, schematic diagram of rectifier.*

In figure 66, the following "Note" is added after the listing of the WIRE TRACER COLOR CODE column:

Note. The WIRE TRACER COLOR CODE for Amplifier Assembly AN/FRA–1A and Amplifier Assembly AN/FRA–1B is shown in the following chart:

Wire from	Wire to	AN/FRA–1A Wire color code	AN/FRA–1B Wire color code
Rectifier—one side of R335.	Contact on relay K306.	P	D
Rectifier — relay terminal board No. 22.	Contact on relay K303.	G	L
Rectifier — relay terminal board No. 22.	Filament control T308 terminal No. 4.	G	L
Rectifier — relay terminal board No. 22.	Transformer T306.	G	L
Rectifier — relay terminal board No. 23.	Contact on relay K303.	B	M
Rectifier — relay terminal board No. 23.	Filament switch S302.	B	M
Rectifier — relay terminal board No. 26.	Relay terminal board No. 9.	J	C
Rectifier — relay terminal board No. 26.	Filament switch S302.	J	C
Rectifier — relay terminal K305.	Filament switch S302.	J	C
Rectifier — relay terminal board No. 11.	Relay K303 coil.	G	L
Rectifier — relay K303 coil.	Contact on relay K301.	G	L
Rectifier — relay terminal board No. 20.	Amplifier terminal board No. 20.	Q	E
Rectifier — relay terminal board No. 9.	Amplifier terminal board No. 9.	J	C
Amplifier terminal board No. 33.	Amplifier terminal board No. 9.	J	C
Amplifier terminal board No. 33.	Filament switch S207.	J	C
Amplifier terminal board No. 35.	Filament switch S207.	B	M
Amplifier terminal board No. 35.	Relay terminal K203.	B	M
Relay terminal K203.	Relay terminal K202.	B	M
Amplifier terminal board No. 37.	Relay terminal K202.	G	L
Amplifier terminal board No. 37.	Bias Switch S202.	G	L
Amplifier terminal board No. 39.	Contact on relay K206.	C	E
Amplifier terminal board No. 39.	Bias switch S202.	C	E
Contact on relay K206.	Biasrectifier chassis terminal board No. 65.	C	E
Amplifier terminal board No. 54.	Transformer T204.	H	L
Amplifier terminal board No. 55.	Filament contact T203 terminal No. 4.	H	L
Amplifier terminal board No. 56.	Filament contact T203 terminal No. 1.	H	L
Amplifier terminal board No. 56.	Contact on relay K202.	G	L
Transformer terminal T201.	Terminal on bias rectifier primary switch S219.	B	M
Transformer terminal T201.	Terminal on bias rectifier primary switch S219.	G	L
Transformer terminal T202.	Terminal on bias rectifier primary	B	M

Wire from	Wire to	AN/FRA–1A Wire color code	AN/FRA–1B Wire color code
Transformer terminal T202.	switch S219. Terminal on bias rectifier primary switch S219.	G	L

In figure 66, the following notes are added:

6—On Amplifier Assembly AN/FRA–1B, tube type 3B28 is used in place of tube type 866A/866 as the bias rectifier tube.

7—On Amplifier Assembly AN/FRA–1B, plate transformers T301, T302, and T303 are provided with a supplementary tap which is to be used at high altitudes. This tap is not shown on this figure. Refer to figure 17.1 for proper connection.

In figure 69, "WEIGHT OF RECTIFIER = 2000 LBS." is changed to read—WEIGHT OF RECTIFIER = **1,700 LB.***; "WEIGHT OF AMPLIFIER = 900 LBS." is changed to read—WEIGHT OF AMPLIFIER = **1,650 LB.**

In figure 69, the following is added:

WEIGHT OF ANTENNA TUNING UNIT = 2,600 LB.

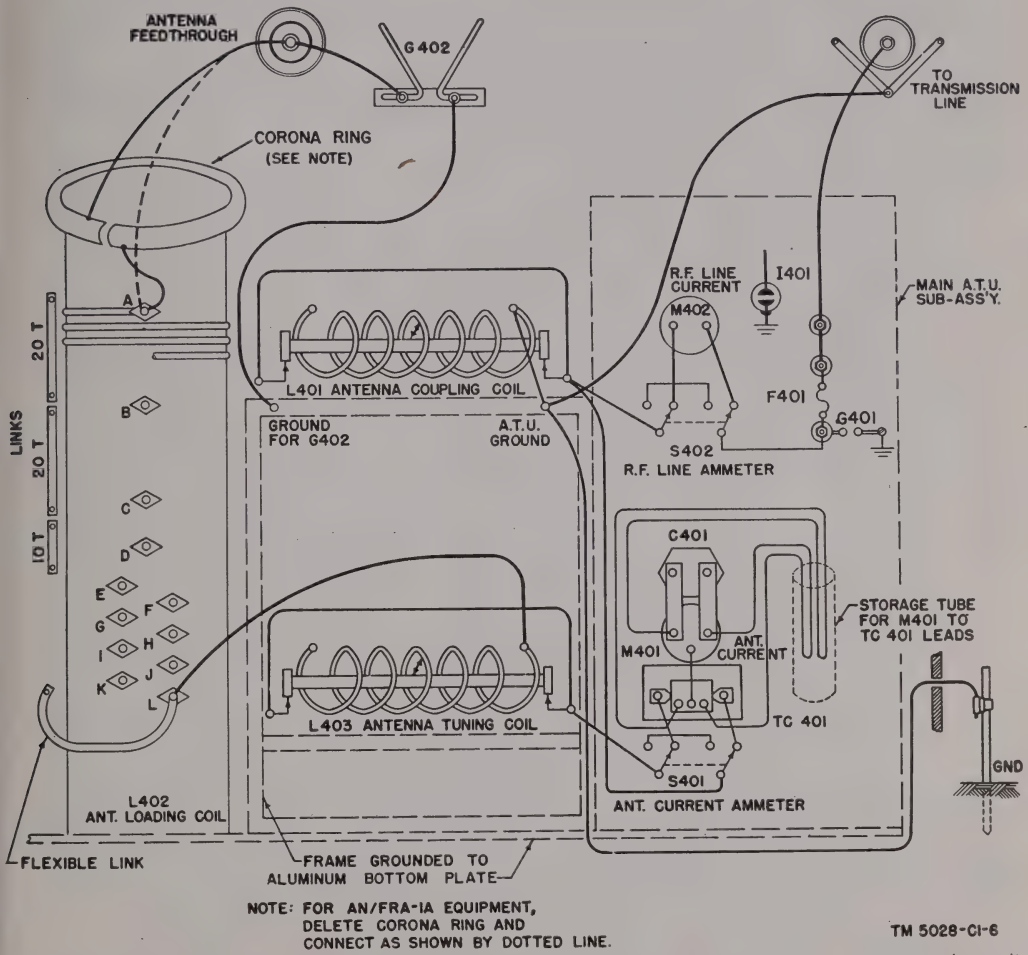


Figure 67 (Superseded). *Amplifier Assembly AN/FRA–1(*), practical wiring diagram for antenna tuning unit.*

*Does not include the three plate transformers.

APPENDIX IV
IDENTIFICATION TABLE OF PARTS
(Added)

1. Requisitioning Parts

The fact that a part is listed in this table is not sufficient basis for requisitioning the item. Requisitions must cite an authorized basis, such as a specific T/O&E, T/A, SIG 7–8–10, list of allowances of expendable material, or another authorized supply basis. The Department of the Army Supply Catalog applicable to the equipment covered in this manual is SIG 7&8–AN/-FRA–1. For an index of available supply catalogs in the Signal portion of the Department of the Army Supply Catalog, see the latest issue of SIG 1.

2. Identification Table of Parts for Amplifier Assembly AN/FRA–1B

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	MAJOR ITEMS		
	AMPLIFIER, RF: freq range 150 to 550 kc; output 6 to 10 kw; CW and 170 cps freq shift keying emission; ambient operating temp 0° C (32°F.) to 55°C. (131°F.); dimen 60" wd x 76" h x 36" d; Rad Receptor dwg #A–431–283.	Radio-frequency power amplifier.	3C332–9
	ANTENNA TUNING UNIT: freq range 150 to 550 kc; input impedance 350 ohms; input power 6 kw; designed for antenna load of 6 to 12 ohm resistance and 750 to 3000 μf capacitance; temp range —65°C. to +55°C. and 0% to 100% relative humidity; dimen 83¾" wd x 61½" d x 110" h; Rad Receptor dwg #A–431–712.	Resonates antenna and matches antenna to transmission line.	2Z11150–37
	RECTIFIER UNIT: input 200 to 240 v ac, 50/60 cyc, 3 ph, 19.15 kva max at 240 v ac; output v hv 8.7 kv ±5% at full load, and at test-tune 5.1 kv ±10%; hv regulation 2.75% full load to bleeder load; ripple v .9% at full load; dimen 60" wd x 76" h x 36" d; Rad Receptor dwg #A–431–495.	Supplies power for amplifier	3H4856–21
	AMPLIFIER GROUP		
B201	BLOWER: centrifugal vane; electric motor operated; 44 blades; 7" approx diam; motor ½ hp, 1725 rpm, 60 cyc, 1435 rpm, 50 cyc; 3 ph 220/440 ac; 13$\frac{13}{16}$" h x 14$\frac{11}{16}$" wd x 17$\frac{7}{16}$" d; 1200 cfm at 1725 rpm, 1000 cfm at 1435 rpm; single direct drive; counterclockwise rotation as seen from shaft end; outlet 6⅞" x 5¾" horizontal; 3 point pedestal mtg; 8¼" x 10$\frac{5}{16}$" mtg/c; Rad Receptor dwg #C–431–49.	General ventilation	6Z995
	BOARD, terminal: 2 brass term; ⅝" between term; molded phenolic blocks; 2⅛" lg x 1½" h x 1$\frac{5}{16}$" wd; one $\frac{5}{16}$" x ⅜" slot; T-shaped slot for joining adjacent term board mtg bracket.	For connections	3Z770–2.13
C206	CAPACITOR, fixed: mica; 25 $\mu\mu$f ±4%; 32,000 v RF peak; Eimac type #VC25–32.	V201 neutralizing	3D9025–57
C208 through C213	CAPACITOR, fixed: mica; 390 $\mu\mu$f ±5%; 30,000 v peak; JAN type CM90C391J.	V201 plate tuning	3K9039132

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	AMPLIFIER GROUP—Continued		
C201, C202, C203, C227	CAPACITOR, fixed: mica; 1000 μμf ±5%; 6000 v peak; JAN type CM75C102J.	V201 grid tuning	3K7510232
C216 through C219, C232, C233	CAPACITOR, fixed: mica; 1000 μμf ±5%; 10,000 v peak; JAN type CM80C102J.	V201 plate loading	3K8010232
C228, C229	CAPACITOR, fixed: mica; 1500 μμf ±5%; 15,000 v peak; JAN Type CM85C152J.	C228: V201 grid tuning C229: Isolates transmission line and EMERGENCY TUNING SWITCH during emergency operation.	3K8515232
C207, C220	CAPACITOR, fixed: mica; 4300 μμf ±5%; 1200 v peak; JAN type CM85B432J.	C207: V201 plate blocking C220: V201 plate decoupling	3K8543222
C204, C205	CAPACITOR, fixed: mica; 4700 μμf ±5%; 6000 v peak; JAN type CM75B472K.	C204: V201 grid blocking C205: V201 grid return bypass.	3K7547222
C224, C225, C226	CAPACITOR, fixed: mica; 10,000 μμf ±10%; 1200 vdcw; JAN type CM55B103K.	C224: M201, GRID CURRENT meter, bypass. C225: M202, PLATE CURRENT meter, bypass. C226: M204, FIL. VOLTAGE meter r-f bypass.	3K5510321
C221, C222, C234 through C237	CAPACITOR, fixed: mica; 47,000 μμf ±10%; 600 vdcw; JAN type CM60D473K.	C221, C222, C236, and C237: V201 filament bypass. C234 and C235: FIL. VOLTAGE meter, r-f bypass.	3K6047341
C231	CAPACITOR, fixed: paper; 1 μf ±10%; 600 vdcw; JAN type CP54B1FF105K.	C231: V201 filament center-tap bypass.	3DB1–236
C223	CAPACITOR, fixed: paper; 4 μf ±10%; 3000 vdcw; JAN type CP70E1DL405K.	C223: V201 grid bias filter	3DB4–272
S202	CIRCUIT BREAKER: thermal; 2 pole; 125/250 v ac/dc, 15 amp; time delay action, 20 to 30 sec for 200% overload; toggle action manual reset; 1 thermal time delay element per pole operates on a common trip, so that an overcurrent on any pole opens the breaker; I-T-E #ET–1230, front connection.	BIAS switch	3H900–15–41
S207	CIRCUIT BREAKER: thermal; 2 pole; 125/250 v ac/dc, 20 amp; time delay action, 20 to 30 sec for 200% overload; toggle action manual reset; 1 thermal time delay element per pole operates on a common trip, so that an overcurrent on any pole opens the breaker; I-T-E #ET–1232, front connection.	FILAMENT switch	3H900–20–22
	CLEANER, air: galv; Air-Maze #R–82S	Air cleaner	6Z3856–74
	CLIP ASSEMBLY, resistor: c/o 1 phosphor bronze fuse clip, nickel pl; 60 amp, 250 v; Kolten type #31–60; 1 brass tab.	Mounts resistors	2Z2712.63
	CLIP: c/o 1 phosphor bronze fuse clip, nickel pl; 60 amp, 600 v; Kolten type #31–60; 1 brass tab.	Mounts resistors	2Z2712.64
	COIL, relay: Price Elec #5803–1; 80 v DC; 2000 ohms dc resistance; impr for tropical use.	For bias interlock relay K201	3C1128–2

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	AMPLIFIER GROUP—Continued		
	COIL, Relay: Price Elec #3309–2; 200/240 v ac, 50/60 cyc; 270 ohms dc resistance; impr for tropical use.	For filament relay K202	3C1128–3
	COIL, relay: Price Elec #3305–3; 200/240 v ac, 50/60 cyc; 380 ohms dc resistance; impr for tropical use; Price Elec dwg #R–2026–B.	For relays K203, K204, and K206.	3C1128–4
L202	COIL, rf: single wnd, single layer wnd; unshielded; 10 mh inductance; Q = 200, at 50 kc; 6.8 ohms dc; 407 turns DCC wire; phenolic form, air core; coil marked L202; mp and fp for tropical use; Rad Receptor dwg #D–2553–51.	V201 plate choke	3C335–25
L203	COIL, RF: single layer, single wnd; unshielded; phenolic form JAN type LTS-E-4 (PBE per JAN–P–79; air core; 56 turns, 7 turns per inch, wnd w/#10 bare tinned copper wire; coil mts term board; 6 stud term; coil tapped at 10th, 19th, 27th, and 34th turns; coil marked L203; mp and fp for tropical use; Rad Receptor dwg #D–2553–75.	V201 plate, harmonic suppressor.	3C335–26
L207	COIL, RF: single wnd, single layer wnd; unshielded; 29 turns, wnd w/#10 bare tinned copper wire; phenolic form JAN type LTS–E–4 (PBE) per JAN–P–79; air core; 1 solder lug term at ea end of coil; tapped at 8th, 13th, 17th, 25th, and 29th turn; coil marked L207; mp and fp for tropical use; Rad Receptor dwg #D–2553–100.	Emergency antenna tuning	3C1084Z12–10
L208	COIL, rf: single wnd, single layer wnd; unshielded; 5 mh at 150 kc; 100 ma; 54 ohms dc; 350 turns, #28 DCC enameled wire; phenolic form JAN type LTS–E–4 (PBE); air core; 1 solder lug term at ea end of wnd; coil marked L208; mp and fp for tropical use; Rad Receptor dwg #D–2553–26.	V201 grid choke	3C335–27
L209	COIL, rf: single wnd; unshielded; 8 turns ¼" apart; self-supporting; #10 soft tinned copper wire; mp and fp for tropical use; Rad Receptor dwg #B–2553–125.	V201 grid, parasitic suppressor.	3C335–28
	CONTACT SET, relay: c/o 2 cont arms ea w/one ⅜" diam silver cont Price Elec #P–1125, 2 cont arms ea w/one ⅜" diam silver cont Price Elec #P–1126, 2 cont bridges ea w/two ⅜" diam silver cont Price Elec #P–861; tropicalized; p/o Price Elec #3305–3.	For relays K203, K204, and K206.	2Z3196–31
	CONTACT SET, relay: c/o 2 cont arms ea w/one ⅜" diam silver cont Price Elec #P–1125, 2 cont arms ea w/one ⅜" diam silver cont Price Elec P–1126, 2 cont arms ea/w/one ⅜" diam silver cont Price Elec #P–1026, 3 cont bridges ea w/two ⅜" diam silver cont; Price Elec #P–861.	For filament relay K202	2Z3196–32
	CONTACT SET, relay: c/o one 5/16" diam silver cont on clip per Cramer RW dwg #A2–8, two 5/16" diam silver cont on left-hand arms per Cramer RW dwg #B2–7; tropicalized; p/o Cramer RW #TC–5M.	For blower delayed-release timing relay K205.	2Z3196–33

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	AMPLIFIER GROUP—Continued		
S203, S220	CONTACT SET, switch: HV; SP, normally open; gravity operated; assem c/o 1 mtg plate; 1 movable cont gnd to base of switch by metal strap, fixed cont mtd on 1¼" diam x 4" lg ceramic post JAN type NS3W0532; cont rated at 10,000 v, 20 amp; Rad Receptor dwg #C–431–433.	High-voltage grounding (circuit is grounded when door is opened).	3Z1715–10.1
	COUPLING, rigid: sleeve; brass, nickel pl; Rad Receptor dwg #A–431–133.	Shaft coupling	2Z3273–222
	COUPLING, flexible: ceramic ins; Cardwell type C #5004, mod per Rad Receptor dwg #B–431–196.	Shaft coupling	2Z3273–223
	DUCT, air duct: clear vinyl; Rad Receptor dwg D–431–194.	Air intake for cooling amplifier tubes.	6Z3660–11
	DUCT, air: clear vinyl; Rad Receptor dwg #D–431–193.	Air intake for cooling unit	6Z3660–12
	INSULATOR, bowl: conical shape; L5 grade ceramic, white, outside surface glazed; JAN–I–10 spec; Genceraco #1088–00.	Insulator	3G1350–33
	INSULATOR, bushing: conical shape; white glazed steatite; JAN type NS3W4203; Alsimag #1174.	Insulator	3G3542–03
	INSULATOR, bushing: conical shape; white glazed steatite; JAN type NS4W4502; Alsimag #1151.	Insulator	3G3545–02.1
	INSULATOR, standoff: round post shape; JAN type NS4W0308; Alsimag #1010.	Insulator	3G3503–08.1
	INSULATOR, standoff: round post shape; JAN type NS3W0312; Alsimag #1012.	Insulator	3G3503–12
	INSULATOR, standoff: round post shape; white glazed steatite; JAN type NS4W0316; Alsimag #1013.	Insulator	3G3503–16.1
	INSULATOR, bushing: grade L4 ceramic, white, unglazed; Rad Receptor dwg #A–2635–214.	Insulator	3G100–174
	INSULATOR, standoff: round post shape; white glazed steatite; JAN type NS3W0512; Alsimag #1020.	Insulator	3G3505–12
	INSULATOR, standoff: round post shape; white glazed steatite; JAN type NS3W0516; Alsimag #1021.	Insulator	3G3505–16
	INSULATOR, standoff: round post shape; white glazed steatite; JAN type NS3W0532; Alsimag #1025.	Insulator	3G3505–32
	KNOB: round; c/o handwheel, 7" diam, molded blk phenolic, Cont Diamond dwg #XK–2013, modified; ¾" diam brass insert for ⅜" diam shaft.	GRID TUNING and PLATE TUNING controls.	2Z5822–225
	KNOB: round; c/o handwheel, 4½" diam, molded blk phenolic, Cont Diamond dwg #XK–1459, modified; ¾" diam brass insert for ½" diam shaft; knob plug button; mtg hardware; o/a dimen 4½" diam x 1⅜" h.	FILAMENT CONTROL	2Z5822–223
	KNOB: round; black bakelite; for ¼" diam shaft; 41/64" depth of hole; two #10–32 Allen head setscrews; white indicator line marking; 2 1/16" diam x ⅞" h o/a; brass insert; Kurz-Kasch #S–311–64–BBB–L.	Control knob	2Z5835

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	AMPLIFIER GROUP—Continued		
	KNOB: round; black bakelite; for ¼" diam shaft; $41/64$" depth of hole; two #10–32 Allen head setscrews; white indicator line marking; 3" diam x $1\frac{1}{8}$" h o/a; brass insert; Kurz-Kasch #S–312–64–BBB–L.	Control knob	2Z5822–48
	KNOB: round; black bakelite; for ¼" diam shaft; ½" depth of hole; two #10–32 Allen head setscrews; $1\frac{5}{8}$" diam x ¾" h o/a; brass insert; Kurz-Kasch #S–309–64–BBB.	Control knob	2Z5822–88
I201, I204	LAMP, incandescent: 120 v, 6 w, .05 amp; bulb S–6, clear; candelabra base; tungsten fil 1500-hr life; burn any position; GE Mazda #6S6.	I201: Filament pilot. I204: Grid bias pilot.	2Z5941
I202, I203	LAMP, incandescent: 120 v, 25 w, .20 amp; bulb T–10, inside frosted; med screw base; tungsten fil, 1000-hr life; burn any position; GE Mazda #25T10/IF.	Meter illumination	6Z6820–27
I205	LAMP, glow: 1 w; 105/125 v; bulb G–10, clear; med screw base; neon; GE Mazda #NE30.	Neutralizing indicator	2Z5890–8
	LAMPHOLDER: med screw; ceramic body; 600 v, 660 w; Pass & Seymour #5401.	For meter illumination lamps	2Z5886–30
	LIGHT, indicator: $1\frac{1}{8}$" diam green smooth lens; candelabra screw base, S–6 bulb; 7.5 w; enclosed nickel pl brass shell; slotted jewel; 2 screw term located opposite sides of base of socket; Dialco #31901–11.	For FILAMENT pilot lamp	2Z5884–12
	LIGHT, indicator: $1\frac{1}{8}$" diam amber smooth lens, candelabra screw base, S–6 bulb; 7.5 w; enclosed nickel pl brass shell; slotted jewel; 2 screw term located opposite sides of base of socket; Dialco #31901–11.	For grid bias pilot lamp	2Z5884–99
M201	METER, ammeter: dc; JAN type MR36W200DC-MA.	GRID CURRENT meter	3F920–32
M202	METER, ammeter: dc; JAN type MR35W002DC-AA.	PLATE CURRENT meter	3F1002–21
M203	METER, ammeter: rf; JAN type MR35W010RF-AA; range 0–10 amp; spec JAN–I–6; round molded phenolic flush mtg case; barrel 2.80" diam, 1.66" lg behind flange, round flange 3.5" diam; calibrated for nonmagnetic panel; black numerals and pointer, white background; self-contained.	R. F. LINE CURRENT meter	3F1010–25
M204	METER, voltmeter: ac; JAN type MR35WO30-ACVV.	FIL. VOLTAGE meter	3G8030–12
	MOTOR, self-synchronous: 230 v, 3.4 w, 60 cyc; ½ rpm; closed frame; Haydon series #1600; p/o Cramer RW #TC–5M.	For blower delayed-release timing relay K205.	3H3000S–10
	MOUNT, vibration: steel mtg plate w/rubber cushion; rated load 24 lb; steel sleeve w/5/16" diam hole; 4 mtg holes in plate .166" diam on $1\frac{3}{4}$" mtg/c; Lord #150P12.	Mounts motor	2Z8502–1
	MOUNTING: end piece for term board; molded phenolic block; one $\frac{3}{16}$" x ⅜" mtg slot; T-shaped projection for joining adjacent term board.	For mounting terminal boards	3Z770–2.12
L205	REACTOR: filter choke; 10 hy, 450 ma; 65 ohms dc resistance; 4000 v RMS test; HS metal case, vacuum varnish impr w/asphalt base compound; tropicalized; Freed Trans part/dwg #15105.	Bias supply filter	3C575X–3

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	AMPLIFIER GROUP—Continued		
K201	RELAY, solenoid: SPST normally open; cont rating 5 amp, 200/240 v, 60 cyc; single wnd coil; 80 v dc, .040 amp operating current, .025 amp releasing current; coil dc resistance 2000 ohms; insulated; solder lug term on coil and screw lug term on cont; 2 1/16" lg x 1 7/8" wd x 2 1/4" d; four #8–32 tapped holes on 3/4" x 5/8" mtg/c; fast acting; impr for tropical use; Price Elec #5803–1.	Bias interlock	2Z7587–190
K202	RELAY, solenoid: SPST normally closed on bottom, DPST normally open on top; cont rating 20 amp at 230 v ac; silver, self-wiping cont; 3/8" diam; single wnd coil, 200/240 v ac, 50/60 cyc; .062 amp at 230 v; coil dc resistance 270 ohms, insulated; stud term on coil and cont, front connected; 6 5/8" h x 4 3/4" wd x 2 1/4" d; four .196" diam holes on 4" x 5 7/8" mtg/c; fast acting; impr for tropical use; Price Elec #3309–2 (front connected).	Filament relay	2Z7599A–44
K203, K204, K206	RELAY, solenoid: DPST normally open; silver, self-wiping cont, 3/8" diam; rating 20 amp, 230 v ac; single wnd coil, 200/240 v ac, 50/60 cyc, .032 amp at 230 v; coil dc resistance 380 ohms; ins stud term on coil and cont, front connected; 5 1/2" h x 4 3/4" wd x 2 1/4" d; three .196" diam holes on 4" x 4 3/4" mtg/c; fast acting; impr for tropical use; Price Elec #3305–3 (front connected).	K203: Blower relay K204: Blower delayed-release relay. K206: Bias supply primary relay.	2Z7590–181
K205	RELAY, time delay: SPST pole, normally closed; cont rating 10 amp, 230 v ac; silver, self-wiping cont; 1/8" diam; 60 cyc synchronous motor; screw lug term on motor and cont; 4 1/2" lg x 3" wd x 2 1/8" d o/a; four .140" diam holes on 4 1/8" x 2 5/8" mtg/c; slow acting, 5-min time delay; impr for tropical use; Cramer RW #TC–5M.	Blower delayed-release timing	2Z7587–191
R217	RESISTOR, fixed: comp; ceramic; 100 ohms ± 10%; 8.5 w; E characteristic; 3/4" diam x 4" lg; uninsulated, moisture resistant; 2 nickel metallized term, 3/4" diam x 1/2" lg.	V201 grid, parasitic suppressor.	3Z6010–216
R220 through R227	RESISTOR, fixed; WW; noninductive; 1 ohm ± 10%; 40 w at 315°C; plaque type 4 5/8" lg x 1 1/4" wd x 1/2" h; ceramic body w/fused-on vitreous enamel over resistance wire; resistant to humidity; 2 solder lug term, 3/16" wd x 1/2" lg; 2 mtg slots, 1/16" wd x 1/8" mtg/c; WL #40P.	V201 grid, current limiting	3Z4801–13
R201, R218	RESISTOR, fixed: WW; 20 ohms ±5%; 140 w; JAN type RW10D200.	V201 plate circuit decoupling	3RW14111
R204 through R209, R211, R212, R213	RESISTOR, fixed: WW; 500 ohms ±5%; 140 w; JAN type RW10D501.	R204 thru R209: Bias supply bleeder. R211, R212, and R213: Current limiting resistors for high-voltage grounding switches S203 and S220.	3RW22529
R202, R203	RESISTOR, fixed: WW; 3100 ohms ±5%; 50 w; JAN type RW13D312.	V201 grid leak resistors	3RW27902

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	AMPLIFIER GROUP—Continued		
R216, R219	RESISTOR, fixed: WW; 3100 ohms ±5%; 18 w; JAN type RW33D312.	R216: I201, filament pilot, dropping. R219: I204, grid bias pilot, dropping.	3RW27322
R210	RESISTOR, variable: WW; 250 ohms +15% —10%; 100 w; JAN type RP251FD251LK.	Bias interlock relay K201 adjustment.	3RP6307
X201	SOCKET, tube: 1 cont, tube mtg assem; above-chassis base mtg; round, white porcelain glazed bushing w/chromium pl ferrule of soft copper at top and cast aluminum w/gray finish at base; copper chromium pl cont; Johnson EF #124–220–1 w/stud assem.	Socket for V201	2Z8671.72
X202, X203	SOCKET, tube: 4 cont, UX bayonet base; above chassis base mtg; round, white porcelain glazed base w/aluminum shell; beryllium copper nickel pl cont; Johnson EF #123–209B.	X202: Socket for V202 X203: Socket for V203.	2Z8674.177
G201 through G205	SPARKGAP ASSEMBLY: electrode type; adj; c/o two #10–32 thd stud and ball assem; brass nickel pl; 2½" lg o/a; ball electrodes ½" diam, 1 electrode gnd to base, other electrode mtd w/plate on ceramic post, 1¼" diam x 4" lg; JAN type NS3WO532; knurled nut adjusts distance between balls; Rad Receptor dwg. #C–431–141.	G201: V201 grid protection G202: V201 plate protection. G203: V201 plate capacitor protection. G204: V201 load capacitor protection. G205: GRID TUNING protection.	2Z8808–31
S204, S216, S217, S218	SWITCH ASSEMBLY: phenolic form; opening capacity 7½ amp, 110/220 v ac, or 5 amp at 125 v dc noninductive load; GE type #7460330–G4.	Door interlocks	3Z9560–7
S201	SWITCH, rotary: 2 pole, 2 position; 2 sect; silver cont; steatite stators and rotors; Rad Receptor dwg #C–431–56, item #1.	M203, R. F. LINE CURRENT meter, disconnect.	3Z9825–12.23
S205	SWITCH, rotary: 3 pole, 3 position; 3 sect; silver cont; steatite stators and rotors; nonshorting cont; normally closed; solder lug term; Rad Receptor dwg #C–431–53.	GRID FUNCTION SWITCH	3Z9825–12.25
S210	SWITCH, rotary: 3 pole, 6 position; 3 sect; silver cont; steatite stators and rotors; nonshorting cont; solder lug term; Rad Receptor dwg #C–431–52.	GRID TUNING SWITCH	3Z9825–12.26
S219	SWITCH, rotary: 2 pole, 3 position; 2 sect; silver cont; steatite stators and rotors; nonshorting cont; solder lug term; Rad Receptor dwg #C–431–55.	BIAS RECTIFIER PRIMARY SWITCH.	3Z9825–12.22
S221	SWITCH, rotary: 1 pole, 6 position; 1 sect; silver cont; steatite stator and rotor; nonshorting cont; solder lug term; Rad Receptor dwg #C–431–54.	EMERGENCY TUNING SWITCH.	3Z9825–12.24
S208	SWITCH, sensitive: JAN type SS06B20; SPDT; 5 amp, 250 v; phenolic body; 2.437" lg x .667" wd x 1¾" d o/a; hinge leaf type.	Air Interlock	3Z9558–39.9
	TERMINAL, lug: solderless type; copper, cadmium pl; for #4 AWG wire; screw secures wire; Ilsco #SLS–125–A.	Wire termination	3Z12073–63
T202	TRANSFORMER, power: input 200/220/240 v, 50/60 cyc, single ph; single output wnd; secd 2.55 v at 10 amp CT; 1500 v insulation pri, 4000 v insulation secd; air coolant, vacuum varnish impr w/asphalt base compound; HS case; impr for tropical use; Freed Trans part/dwg #15109.	V202 and V203 filament	2Z9600.139

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	AMPLIFIER GROUP—Continued		
T201	TRANSFORMER, power: input 200/220/240 v, 50/60 cyc, single ph; single output wnd, output 3260 v CT, 450 ma; 1500 v insulation pri, 5000 v insulation secd; air coolant, vacuum varnish impr w/asphalt base compound; HS metal case; impr for tropical use; Freed Trans part/dwg #15108.	Bias supply plate	2Z9601.83
T204	TRANSFORMER, power: input 220 v, 50/60 cyc, single ph; 1 output wnd; secd 22.2 v at 60 amp CT; 1500 v insulation pri, 1500 v insulation secd; air coolant, vacuum varnish impr w/asphalt base compound; HS impr for tropical use; Freed Trans part/dwg #15110.	V201 filament	2Z9600.138
L201	TRANSFORMER, variable rf: stator single wnd, single layer wnd; rotor single wnd, single layer wnd; unshielded, stator 136 turns total; rotor 43½ turns total; #5–32–38 double nylon litz; phenolic forms LTS–E–4 (PBE), air core; stator holds term board parallel to lg dimen; stator tapped at 30th, 61st, and 96th turns; marked L201; mp and fp for tropical use; Rad Receptor dwg #D–2635–179.	V201 GRID TUNING variometer.	2Z9629–303
L206	TRANSFORMER, variable rf: stator, 2 sect wnd #12–32–38 ltz, single layer wnd, 65⅜ turns total, spaced 3 turns/inch, occupying 24¼" incl gap for rotor shaft; phenolic forms LTS–F–4 (PBE), air core; tapped at 10th, 20th, 31st, 44th, and 65th turns; rotor has 21½ turns #12–32–38 litz single wnd, single layer wnd, 3 turns per inch, occupying 8" incl gap for rotor shaft; phenolic form LTS–E–4 (PBE), air core; 8 slotted ceramic ribs spaced 45 deg apart giving wnd diam of 8½" 6 stud term #10–32 x 1⅛" lg brass, nickel pl; mp and fp for tropical use; Rad Receptor dwg #D–2635–200.	V201 PLATE TUNING variometer.	2Z9629–61
T203	TRANSFORMER, variable power: input 115/230 v, 50/60 cyc, and 115 v, 25 cyc, single ph; output range w/230 v input is 0 to 270 v, 8 amp. 2.30 kva; output range w/115 v input is 0 to 270 v, 4 amp, 1.15 kva; output range w/115 v 25 cyc input is 0 to 135 v, 8 amp, 1.15 kva; varied by 4½" diam handwheel; air cooled; open metal case; 7 screw and solder lug term mtd on side; three ¼"–28 tapped holes spaced 120 deg on 3" rad; impr for tropical use, 2 extra brushes supplied mtd inside of term box cover; Rad Receptor dwg #C–2919–10.	V201 FILAMENT CONTROL	2Z9957–38
V201	TUBE, electron: JAN–891R; triode	R-f power amplifier	2J891R
V202	TUBE, electron: JAN–891R; diode	Bias rectifiers	2J3B28
V203			
	ANTENNA TUNING GROUP		
C401	CAPACITOR, fixed: mica; 10,000 $\mu\mu$f ±10%; 1200 vdcw; JAN type CM55A103M.	ANTENNA CURRENT meter M401 r–f bypass.	3K5510321
L401, L403	COIL, RF: single wnd; unshielded; varied by handwheel; 150 kc to 550 kc; coil inductance 125 mh max; stator assem c/o coil wnd w/½" OD copper tubing, silver pl; 24 turns, wnd pitch ¾" c to c; air core; rotor assem c/o 3" diam disc	L401: ANT. COUPLING L403: ANT. TUNING	3C1084Z12–12

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	ANTENNA TUNING GROUP—Continued		
	roller revolving on 7/16" diam shaft attached to main shaft by two 6⅛" lg x 3" wd x ½" thk metal posts; main shaft ⅜" diam x 30" lg, balanced by counterweight on 1 end, opposite rotor roller; rotor supported mechanically by 2 Mycalex bars, 2¼" wd x 10⅞" lg x ½" thk, 1 at ea end; o/a dimen 16" h x 16⅜" wd x 30" lg; assem mtd to antenna tuning unit frame by four 5/16"–18 x ½" lg RH machine screws, brass nickel pl, on 8½" x 27⅛" mtg/c; mp and fp for tropical use; Johnson EF #224–7–2.		
L402	COIL, RF: single wnd; single layer wnd; unshielded; 70 turns of #1080–38 DSC litz wire, tapped from top down at 20, 40, 50, 53, 55, 58, 60, 63, 65, 68, and 70 turns; term assem cast bronze, silver pl and stamped w/letters A thru L; phenolic form, type LTS–E–4(PBE), air core; 15 sets of slotted ribs, 2 per set, ceramic per JAN–I–10, mtd lengthwise on coil and spaced 24 deg apart, giving effective wnd diam of 25½"; corona ring, alum, w/7 mtg holes, 5/16" diam on 10¼" rad, 5 spaced 48° apart and 2 spaced 60° apart; impr for tropical use; Rad Receptor part #L402, dwg #D2553–12.	Antenna loading	3C1084Z12–11
	COUPLING, flexible: Cardwell #5004, modified per Rad Receptor dwg #B–431–196; ceramic insulation.	Shaft coupling	2Z3273–223
F401	FUSE LINK: 6 amp; fuse wire; .046" diam x 4" lg; instantaneous.	Protects R. F. LINE CURRENT meter M402.	1A406
	INSULATOR, bowl: conical shape; L5 grade ceramic, white, outside surface glazed; Genceraco #1088–00; assem per Rad Receptor dwg #B–431–670.	Insulator	3G1350–33
	INSULATOR, bushing: grade L4 ceramic, white, unglazed; Rad Receptor dwg #A–2553–10.	Insulator	3G100–175
	INSULATOR, feedthru: double bowl shape; white porcelain glazed; includes ½" diam thd feedthru stud; two 6⅛" diam corona shields; 2 rubber washers, 2 flat washers, two ½"–13 elastic stop nuts, brass, nickel pl, two ½"–13 x ⅞" x 19/64" thk hex nuts, brass nickel pl; Lapp type #9167.	Insulator	3G1350–97
	INSULATOR, standoff: round post shape; JAN type NS3WO308; Alsimag #1010.	Insulator	3G3503–08.1
	INSULATOR, standoff: round post shape; JAN type NS3WO532; Alsimag #1025.	Insulator	3G3505–32
	INSULATOR, standoff: round post shape; JAN type NS3WO512; Alsimag #1020.	Insulator	3G3505–12
	KNOB: round; c/o handwheel, 7" diam, molded blk phenolic, Cont Diamond dwg #XK–2013 modified; ¾" diam brass insert for ⅜" diam shaft; knob plug button, mtg hardware; Rad Receptor dwg #B–431–630.	ANT. COUPLING and ANT. TUNING controls.	2Z5822–225
	KNOB: round c/o handwheel, 4½" diam, molded blk phenolic, Cont Diamond dwg #XK–1459 modified; ¾" diam brass insert for ⅜" diam shaft; knob plug button, mtg hardware; pointer, brass nickel pl, 1½" wd at base, 3 1/16" lg; Rad Receptor dwg #B–431–632.	ANT. CURRENT AMMETER switch control.	2Z5822–519

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	ANTENNA TUNING GROUP—Continued		
	KNOB: round; black bakelite; for ¼" diam shaft; ½" depth of hole; two #10–32 Allen head setscrews; brass insert; Kurz-Kasch type #S–309–64–BBB.	Control knob	2Z5822–88
	KNOB: round; black bakelite; for ¼" diam shaft; 4/64" depth of hole; two #10–32 Allen head setscrews; white indicator line marking; brass insert; Kurz-Kasch type #S–311–64–BBB–L.	Control knob	2Z5835
1401	LAMP, glow: 1 w; 105/125 v; bulb G–10 clear; med screw base; neon; GE #NE30.	R–f indicator	2Z5890–8
	LAMPHOLDER: med screw; ceramic body; 600 v, 660 w; Pass & Seymour #5401.	For r–f indicator	2Z5886–30
M401	METER, ammeter: rf; 0 to 50 amp; JAN type MR35WO50RFAA.	ANTENNA CURRENT meter	3F1050–30
M402	METER, ammeter: rf; 0 to 10 amp; JAN type MR35WO10RFAA.	R. F. LINE CURRENT meter	3F1010–25
	PLATE, grounding: gnd wire held by 3 clamps, ea mtd to standoff ins, JAN type NS3WO312; ea ins mtd by one #10–32 FH machine screw, nickel pl, to bakelite board; 1 ins located 1½" from end of board, other 2 ins follow 9½" apart; bakelite board 31⅝" lg x 1½" wd x ¼" thk; three 9/32" diam mtg holes, 1 hole located 2 1/16" from end of board, other 2 holes follow 13 11/16" apart; assem per Rad Receptor dwg #C–431–727.	Ground mounting for G402	2Z7091–410
G401	SPARKGAP ASSEMBLY: electrode type; adj; c/o two #10–32 thd stud and ball assem, brass nickel pl; ball electrodes ½" diam; 1 electrode grounded to base, other electrode mtd w/plate on ceramic post, 1¼" diam x 4" lg, JAN type NS3WO532; knurled nut adjusts distance between balls; Rad Receptor dwg #C–431–141.	Transmission line protection	2Z8803–31
G402	SPARKGAP ASSEMBLY: hv, adj; c/o 2 horn-shaped aluminum electrodes, ½" diam x 13½" lg; one electrode w/1" diam solid bronze ball mtd on post ins, JAN type NS3W3380, modified per Rad Receptor dwg #B–431–629; gnd electrode mtd to aluminum post; posts attached to aluminum plate 11" lg x 2½" wd x 3/16" thk; plate mtd by 4 standoff ins, JAN type NS3W0312, on 10" x 1⅝" mtg/c to phenolic base 15" lg x 2½" wd x ⅜" thk; sparkgap assem mtd by two #14 x 1½" lg, RH brass, nickel pl wood screws, 13½" apart; 1 screw ¾" above ctr line, other ¾" below ctr line; cloth bag containing eight #14 x 1½" lg RH brass, nickel pl wood screws attached to assem; assem per Rad Receptor dwg #C–431–724.	Protects against lightning surges.	2Z8808–38
	SPRING ASSEMBLY: leaf type cont; 2 springs, ea 1 7/16" wd x 1⅝" h x 1/32" thk, nickel pl beryllium copper; set of 2 springs mtd at ea end of coils by four ¼"–20 x ⅝" lg RH machine screws, brass nickel pl, on 1⅛" x 1 3/16" mtg/c; Johnson EF #16.376–2.	Provides pressure for roller contact to coil; part of L401 and L403.	2Z8877.432
S401	SWITCH, rotary: meter shorting; 2 pole, 2 position; 2 sect; silver pl spring cont; ⅜" diam shaft; Johnson EF dwg #E–145–5 modified per Rad Receptor dwg #D–431–626.	ANT. CURRENT AMMETER switch; disconnects M401.	3Z9825–85.5

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	ANTENNA TUNING GROUP—Continued		
S402	SWITCH, rotary: 2 pole, 2 position; 2 sect; silver cont; steatite stator and rotor; ¼" diam shaft; shorting cont; solder lug term; two #8–32 tapped mtg holes on 4½" mtg/c; Rad Receptor dwg #C–431–56, item #2.	R. F. LINE AMMETER switch; disconnects meter M402.	3Z9825–12.23
TC401	THERMOCOUPLE: external; 50 amp; rectangular molded bakelite case; compensated element, type C; calibrated for use w/Rad Receptor #M401; Weston model #9997.	Thermocouple for ANTENNA CURRENT meter M401.	3F34545–50–1
	RECTIFIER GROUP		
B301	BLOWER: centrifugal vane; electric motor operated; 44 blades; 7" approx diam; motor ½ hp, 1725 rpm, 60 cyc, 1435 rpm, 50 cyc; 3 ph 220/440 AC; 13⅛" h x 14$\frac{13}{16}$" wd x 17$\frac{7}{16}$" d; 1200 cfm at 1725 rpm, 1200 cfm at 1725 rpm, 1000 cfm at 1435 rpm; single speed; direct drive; counterclockwise rotation as seen from shaft end; Rad Receptor dwg #C–431–49.	General ventilation	6Z995
	BOARD, terminal: 2 brass term; ⅝" between term; molded phenolic block; one $\frac{7}{16}$" x ⅜" slot; T-shaped slot for joining adjacent term board mtg bracket.	For connections	3Z770–2.13
	CABLE ASSEMBLY, special purpose: three #14 AWG stranded cond, 19 strands ea cord; thermoplastic insulation, color-coded; 600 v working; black vinylite sleeving $\frac{7}{16}$" OD x .030" thk wall; 20 ft lg excl term; 3 Amphenol #31709 diamond grip spade tongue wire term ea end; tropicalized; Rad Receptor dwg #B–431–337.	For connections	3E7350–1.240.1
C301	CAPACITOR, fixed: paper dielectric; 2μf ±10%; 12,500 vdcw; JAN type CP70D1DT205K.	High-voltage filter	3DB2–170
S301	CIRCUIT BREAKER: magnetic and thermal; 3 pole, 250 v ac, 50/60 cyc, 90 amp; phenolic case; time delay action, 1¼ min to 2½ min for 200% overload; toggle action manual reset; 1 thermal time delay element per pole operates on a common trip, so that an overcurrent on any pole opens the breaker, instantaneous magnetic trip as additional short circuit protection; I-T-E #ET–1980, dwg #90042, front connection.	Main line circuit breaker	3H900–90–1
S302	CIRCUIT BREAKER: thermal; 2 pole; 125/250 v ac/dc, 15 amp; phenolic case; time delay action, 20 to 30 sec for 200% overload; toggle action manual reset; 1 thermal time delay element per pole operates on a common trip, so that an overcurrent on any pole opens the breaker; I-T-E #ET–1230, front connection.	FILAMENT circuit breaker	3H900–15–40
	CLEANER, air: galv; Air-Maze #R–82S	Air cleaner	6Z3856–74
	CLIP: c/o 1 phosphor bronze fuse clip, nickel pl, 60 amp, 600 v, Kolten type #31–60; 1 brass tab; o/a dimen 1⅞" h x 1¾" lg x 1⅛" wd.	Mounts resistors	2Z2712.64
	COIL, relay: 200/240 v, 50/60 cyc; 380 ohms DC resistance; ins; 1⅝" lg x 1⅝" wd x 1¼" h; Price Elec dwg #R–2026–S; p/o Price Elec relay #3305–3; impr for tropical use.	For start-stop auxiliary control relay K302 and for relay K303.	3C1128–4

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	RECTIFIER GROUP—Continued		
	COIL, relay: 200/240 v, 50/60 cyc; 125 ohms dc resistance; ins; 2" lg x 1 5/8" wd x 1 5/16" h; Price Elec dwg #R–1420–C; p/o Price Elec relay #3647–4; impr for tropical use.	For filter capacitor charging relay K306.	3C1128–1
	COIL, relay: 6 v dc; 50 ohms dc resistance; 1" diam x 1 9/16" lg; Price Elec dwg #R–3721–L; p/o Price Elec relay #5806–4; impr for tropical use.	For plate overload relay K307	3C1128
	COIL, relay: 220 v, 50/60 cyc; 5.7 ohms dc resistance; 3" lg x 2 13/16" wd x 2 7/16" h; ins; impr for tropical use; Fed Elec #CB306; p/o Fed Elec AC contractor #31163.	For plate primary relay K305	3C1135
	CONTACT SET, relay: c/o 2 cont arms ea w/one 3/8" diam silver cont Price Elec #P–1126; 2 cont arms ea w/one 3/8" diam silver cont Price Elec #P–1125; 2 cont bridges ea w/two 3/8" diam silver cont Price Elec #P–861; tropicalized; p/o Price Elec relay #A–3305–3.	For start-stop auxiliary control relay K302.	2Z3196–31
	CONTACT SET, relay: c/o one 3/8" diam silver cont on left cont arm Price Elec #P–2786–L; one 3/8" diam silver cont on right cont arm Price Elec #P–2786–R; two 3/8" diam silver cont on cont bridge Price Elec #P–1050; tropicalized; p/o Price Elec relay #3647–4.	For filter capacitor charging relay K306.	2Z3196–34
	CONTACT SET, relay: c/o one 5/16" diam stationary cont on clip per Cramer RW dwg #A2–10; one 5/16" diam silver cont on left-hand arm per Cramer RW dwg #B2–7; tropicalized; p/o Cramer RW relay #TC–60S.	For plate time-delay relay K304.	2Z3196–36
	CONTACT SET, relay: c/o two 5/16" diam silver stationary cont on clip per Cramer RW dwg #A2–10; two 5/16" diam silver cont, 1 on left-hand arm and 1 on right-hand arm per Cramer RW dwg #B2–7; tropicalized; p/o Cramer RW relay #TC–45S.	For start-stop control relay K301.	2Z3196–37
	CONTACT SET, relay: c/o 3 movable main straps, ea w/two 11/16" diam silver cont Fed Elec #31166; 3 stationary line term cont brackets ea w/one 11/16" diam silver cont, Fed Elec #31165; 3 stationary load term cont brackets ea w/one 11/16" diam silver cont Fed Elec #31164; 1 block assem normally open Fed Elec #31167; p/o Fed Elec AC contactor #31163–06.	For plate primary relay K305	2Z3196–35
	COUPLING, rigid: sleeve; brass, nickel pl; Rad Receptor dwg #A–431–133.	Shaft coupling	2Z3273–222
	DUCT, air duct: clear vinyl; Rad Receptor dwg #D–431–194.	Air intake for cooling rectifier tubes.	6Z3660–11
	DUCT, air duct: clear vinyl; Rad Receptor dwg #D–431–193.	Air intake for cooling unit	6Z3660–12
	INSULATOR, bushing: conical shape; white glazed steatite; JAN type NS3W4502; Alsimag #1151.	Insulator	3G3545–02.1
	INSULATOR, standoff: round post shape; JAN type NS3W0308; Alsimag #1010.	Insulator	3G3503–08.1
	INSULATOR, standoff: round post shape; white glazed steatite; JAN type NS4W0316; Alsimag #1033.	Insulator	3G3503–16.1

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	RECTIFIER GROUP—Continued		
	INSULATOR, standoff: round post shape; white glazed steatite; JAN type NS3W0532; Alsimag #1025.	Insulator	3G3505–32
	KNOB: round; c/o handwheel, 4½" diam, molded blk phenolic, Cont Diamond dwg #XK–1459, modified; ¾" diam brass insert for ⅜" shaft; knob plug button; mtg hardware; Rad Receptor dwg #B–431–343.	FILAMENT CONTROL	2Z5822–519
	KNOB: round; c/o handwheel, 7" diam, molded blk phenolic, Cont Diamond dwg #XK–2013, modified; 1" diam brass insert for ⅝" diam shaft; knob plug button, mtg hardware; Rad Receptor dwg #C–431–336.	PRI. VOLTAGE ADJ. and PLATE VOLTAGE control.	2Z5822–225
	KNOB: round; black bakelite; for ¼" diam shaft; 41/64" depth of hole; two #10–32 Allen head setscrews; white indicator line marking; brass insert; Kurz-Kasch #S–311–64–BBB–L.	Control knob	2Z5835
	KNOB: round; black bakelite; for ¼" diam shaft; ½" depth of hole; two #10–32 Allen head setscrews; brass insert; Kurz-Kasch #S–309–64–BBB.	Control knob	2Z5822–88
I301, I302	LAMP, incandescent: 120 v, 6 w, .05 amp; bulb S–6, clear; candelabra base; tungsten fil, 1500-hr life; burn any position; GE Mazda #6S6.	I301: PLATE pilot lamp I302: FILAMENT pilot lamp	2Z5941
I303, I304	LAMP, incandescent: 120 v, 25 w, .20 amp; bulb T–10, inside frosted; med screw base; tungsten fil, 1000-hr life; burn any position; GE Mazda #25T10/IF.	Meter illumination	6Z6820–27
I303, I304	LAMPHOLDER: med screw; ceramic body; 600 v, 660 w; Pass & Seymour #5401.	For meter illumination lamps	2Z5886–30
I301	LIGHT, indicator: 1⅛" diam red smooth lens; candelabra screw base, S–6 bulb; 7.5 w; enclosed brass nickel pl shell; 9/16" max panel thk; horizontally mtd, lamp replaceable from front of panel; slotted jewel; 2 screw term located opposite sides of base of socket; Dialco #31901–11.	For PLATE pilot lamp	2Z5884–13
I302	LIGHT, indicator: 1⅛" diam green smooth lens; candelabra screw base, S–6 bulb; 7.5 w; encl nickel pl brass shell; 9/16" max panel thk; horizontally mtd, lamp replaceable from front of panel; slotted jewel; 2 screw term located opposite sides of socket; Dialco #31901–11.	For FILAMENT pilot lamp	2Z5884–12
M302	METER, time: elapsed time indicator; synchronous self-starting motor, direct reading; automatic start and stop; range 0 to 9999.9 hr, 5 rotating drum counters, ea calibrated 0 to 9; operates from 230 v ac, 60 cyc line; round flush mtg, black molded phenolic case; three 5/32" diam mtg holes on 137/64" rad, 120° apart; three #6–32 x ¾" mtg screws w/lock washers and nuts; unaffected by v fluctuation of ±10%; tropicalized; Cramer RW #E2H.	FIL. HOURS meter	3F9090
M303, M304	METER, voltmeter: ac JAN type MR35W300ACVV.	M303: FIL. PRIMARY voltmeter. M304: LINE VOLTAGE meter.	3F8300–5

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	RECTIFIER GROUP—Continued		
M301	METER, voltmeter: dc; JAN type MR35WO15-DCKV.	PLATE VOLTAGE meter	3F13999–1.6
	MOTOR, self-synchronous: 230 v, 3.4 w, 60 cyc; ½ rpm; closed frame; Haydon series #1600; Cramer RW #TC–5M.	For start-stop control relay K301.	3H3000S–10
	MOUNT, vibration: steel mtg plate w/rubber cushion; rated load 24 lb; steel sleeve w/$\frac{5}{16}$" diam hole; 4 mtg holes in plate .166" diam on 1⅜" mtg/c; Lord #150P12.	Shock mounting	2Z8502–1
	MOUNTING: end piece for term board; molded phenolic block; 2⅛" lg x 1½" h x $1\frac{5}{16}$" wd; one $\frac{5}{16}$" x ⅜" mtg slot; T shaped projection for joining adjacent term board.	For mounting terminal boards	3Z770–2.12
L301	REACTOR: .3 to 1.7 hy, 2 to .2 amp; 5 ohms max d-c resistance; 20,000 x RMS test; HS case, vacuum varnish impr, oil-filled; 4 integral mtg ft, ea w/½" diam hole on 6⅝" x 6⅜" mtg/c; two ⅜"–16 x 1½" lg stud term on standoff ins, 4½" c to c on top of case; tropicalized; Rad Receptor dwg #C–2919–7, spec XT–118C.	High voltage filter swinging choke.	3C323–186A
K307	RELAY, solenoid: DPST, normally closed; cont rating 5/10 amp, 250/125 v ac; relay actuates 2 sensitive switches, JAN type SS04B20; single wnd coil, 6 v dc; .120 amp operating cur, .060 releasing cur; coil d-c resistance 50 ohms, ins; solder lug term on coil and screw lug term on cont; fast acting; impr for tropical use; Price Elec #5806–4.	Plate overload relay	2Z7590–179
K302, K303	RELAY, solenoid: DPST, normally open; silver, self-wiping cont, ⅜" diam; cont rating 20 amp, 230 v ac; single wnd coil, 200/240 v ac, 50/60 cyc, .032 amp at 230 v; coil d-c resistance 380 ohms; stud term on coil and cont, front connected; fast acting; impr for tropical use; Price Elec #3305–3.	K302: Start-stop auxiliary control relay. K303: Filament relay.	2Z7590–181
K306	RELAY, solenoid: SPST, normally open; cont rating 20 amp, 230 v ac; solid silver self-wiping cont, ⅜" diam; single wnd coil, 200/240 v ac, 50/60 cyc, .068 amp at 230 v, 125 ohms d-c resistance, ins; stud term on coil and cont, front connected; fast acting; impr for tropical use; Price Elec #3647–4.	Filter capacitor charging relay	2Z7587–193
K305	RELAY, solenoid: 3PST plus 1 auxiliary cont SPST, normally open; cont rating for main cont, 100 amp, 220 v ac; auxiliary cont 10 amp, 220 v ac; silver self-wiping cont; main cont $\frac{11}{16}$" diam, auxiliary cont ¼" diam; single wnd coil, 220 v ac, 60 cyc, .58 amp, coil d-c resistance 5.7 ohms, screw lug term on coil and cont; fast acting; impr for tropical use; Fed Elec #31163–06.	Plate primary relay	2Z7593–122
K301	RELAY, time delay: DPST, normally open; cont rating 5 amp, 230 v, 60 cyc; 8 rpm synchronous motor, 230v, 60 cyc; lug term on motor, screw term on cont; timing dial adjustable up to 13 sec; slow acting, circuit #1 closes after 11½ sec ±1½ sec time delay, circuit #2 is a momentary type switch, closes in 1 to 1½ sec from	Start-stop control relay	2Z7598151

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	RECTIFIER GROUP—Continued		
	start and opens 1½ sec later, clutch type unit; impr for tropical use; Cramer RW #SA–459; Rad Receptor #K301.		
K304	RELAY, time delay: SPST, normally open; cont rating 10 amp; silver self-wiping cont $\frac{5}{16}$" diam; 1 rpm synchronous motor 230 v ac, 60 cyc; screw term on motor and cont; slow acting, 45 sec time delay; adjustable from 2.5 to 45 sec; impr for tropical use; Cramer RW #TC–45S.	Plate time-delay relay	2Z7587–192
R329, R330, R331	RESISTOR, fixed: WW; 500 ohms ±5%; 140 w; JAN type RW10D501.	Current-limiting resistors for high-voltage grounding.	3RW22529
R301, R302, R303, R306, through R328	RESISTOR, fixed: WW; 2000 ohms ±5%; 140 w; JAN type RW10D202.	R301 thru R303; Filter capacitor charging. R306 thru R328: High-voltage bleeders.	3RW26122
R336, R337	RESISTOR, fixed: WW; 3100 ohms ±5%; 18 w; JAN type RW33D312.	R336: Dropping resistor for PLATE indicator lamp I301. R337: Dropping resistor for I302. FILAMENT indicator lamp	3RW27322
R340	RESISTOR, fixed; WW; 10,000 ohms ±5%; 40 w; JAN type RW14D103.	M301 Shunt	3RW30304
R334, R338, R339	RESISTOR, fixed: WW; 5 megs; 5 kv; JAN type MFA 505.	Multipliers for PLATE VOLTAGE meter M301.	3RM500–1
R335	RESISTOR, variable: WW; 5 ohms +15% –10%; 4.47 amp max cur; JAN type RP251FD5ROLK.	Adjustment for plate overload relay K307.	3RP1806
X301 through X306	SOCKET, tube: 4 cont, 50 w, bayonet base; above chassis base mtg; two $\frac{7}{32}$" diam mtg holes on $2\frac{13}{16}$" mtg/c; round white porcelain glazed base w/aluminum shell; beryllium copper nickel pl cont; Rad Receptor dwg #B–431–341.	X301: Socket for V301 X302: Socket for V302. X303: Socket for V303. X304: Socket for V304. X305: Socket for V305. X306: Socket for V306.	2Z8674.148
G301	SPARKGAP ASSEMBLY: electrode type; adj; c/o 2 ball electrodes ½" diam w/¼" diam rod, 2 blocks $1\frac{5}{16}$" lg x 1" wide x ½" h, blocks have #8-32 tapped hole w/Allen head set screw to adj distance between balls; Harrison Engineering dwg #385.	Protects filter reactor L301	2Z8808–32
S307, S311	SWITCH ASSEMBLY: phenolic form; opening capacity 7½ amp, 110/220 v a-c, or 5 amp at 125 v d-c noninductive load; GE type #7460330–G4; $2\frac{5}{16}$" lg x $1\frac{19}{32}$" wd x $\frac{11}{16}$" h o/a; male part $1\frac{7}{8}$" lg x $\frac{5}{8}$" wd x $\frac{11}{16}$" h; female part $2\frac{5}{16}$" lg x $\frac{13}{16}$" wd x $\frac{11}{16}$" h; two $\frac{5}{32}$" diam holes on $1\frac{13}{16}$" mtg/c on female part; two $\frac{5}{32}$" diam holes on 1¼" mtg/c on male part.	Door interlocks	3Z9560–7
S309, S312	SWITCH ASSEMBLY: HV; SP, normally open; gravity operated; assem c/o 1 mtg plate, 1 movable cont gnd to metal base of switch by metallic strap, fixed cont mtd on 1¼" diam x 4" lg ceramic post, JAN type NS3WO532; cont rated at 20 amp, 10,000 v; three $\frac{7}{32}$" diam mtg holes,	High-voltage grounding (circuit is grounded when door is opened).	3Z1715–10.1

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	RECTIFIER GROUP—Continued		
	2⅛" x 3" mtg/c on mtg plate; Rad Receptor dwg #C–431–433.		
S310	SWITCH, rotary: 2 pole, 3 position; 2 sect; silver cont; steatite stators and rotors; nonshorting cont; solder lug term; two #8-32 tapped holes on 2⅞" mtg/c; 1½" lg shaft, ¼" diam; Rad Receptor dwg #C–431–327.	LINE VOLTAGE metering switch.	3Z9825–12.22
S305	SWITCH, rotary: 3 pole, 2 position; 6 sect; 100 amp, 460 v ac, 250 v dc; silver pl copper stator, silver pl phosphor bronze rotor; phenolic case; solder lug term; panel mtd by four 33/64" diam holes on 5⅝" mtg/c; rear connected; impr for tropical use; Rad Receptor dwg #B–431–449.	HIGH-LOW PLATE VOLTAGE switch.	3Z9825–40.13
S303	SWITCH, rotary; 3 pole, 4 position; 6 sect; 100 amp, 460 v ac, 250 v dc; silver pl copper stator, silver pl phosphor bronze rotor; phenolic case; solder lug term; panel mtd by four 33/64" diam holes on 5⅝" x 5⅝" mtg/c; rear connected; impr for tropical use; Rad Receptor dwg #B–431–325.	PRI. VOLTAGE ADJ. switch	3Z9825–40.14
	SWITCH, sensitive: SPST, JAN type #SSO4B20; 5 amp 250 v; molded case, leaf spring actuator; screw term; two .140" diam mtg holes on 1" mtg/c.	Part of relay K307	3Z9558–39.10
	TERMINAL, lug: solderless type; copper cadmium pl; for #4 AWG wire; screw secures wire; mtg hole ¼" diam; Ilsco #SLS–125–A.	Wire termination	3Z12073–63
T307	TRANSFORMER, power: input 220 v, 50/60 cyc, single ph; single output wnd; secd 5.1 v at 30 amp CT; 1500 v insulation pri, 20,000 v insulation secd; air coolant, vacuum varnish impr, potted w/asphalt base compound; HS metal case; 3 standoff ins on 1 side, 2 1/16" lg, and 2 standoff ins on opposite side, 1 5/16" lg; four ¼"-20 studs on 5¼" x 3¼" mtg/c; impr for tropical use; Freed Trans part/dwg #15107; Rad Receptor dwg #C–2919–3, spec #XT–133–B.	Filament transformer for V304, V305, and V306.	2Z8600.136
T304, T305, T306	TRANSFORMER, power: input 220v, 50/60 cyc, single ph; single output wnd; secd 5 v at 10 amp CT; 1500 v insulation pri, 20,000 v insulation secd; air coolant, vacuum varnish impr, potted w/asphalt base compound; HS metal case; 3 standoff ins on 1 side, 2 1/16" lg, and 2 standoff ins on opposite side, 1 5/16" lg; four ¼"-20 studs on 3¾" x 2¾" mtg/c; impr for tropical use; Freed Trans part/dwg #15106; Rad Receptor dwg #C–2919–2, spec #XT–132–B.	T304: Filament transformer for V301. T305: Filament transformer for V302. T306: Filament transformer for V303.	2Z9600.137
T301, T302, T303	TRANSFORMER, power: input 200/220/240 v, 50/60 cyc, 6.4 kva, single ph; single output wnd; output 3920 v, 1.63 amp, tapped at 3300 v; 2500 v insulation pri, 20,000 v insulation secd; air coolant, oil-filled and sealed; 3 standoff ins on top of case, 4" lg, and 4 standoff ins on top of case, 3¼" lg; 4 integral mtg ft, ea w/ 9/16" diam hole on 12½" x 12½" mtg/c; impr for tropical use; Harrison Engineering Corp dwg #366–B, spec #668; modified per Rad Receptor dwg #C–2919–11, spec #XT–119–D.	Plate power for tubes V301 thru V306.	2Z9612.327

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	RECTIFIER GROUP—Continued		
T308	TRANSFORMER, variable: power; input 115/230 v, 50/60 cyc, and 115 v, 25 cyc, single ph; output range w/230 v input is 0 to 270 v at 2 amp rated cur, .575 kva; output range w/115 v input is 0 to 270 v at 1 amp rated cur, .287 kva; output range w/115 v, 25 cyc input is 0 to 135 v at 2 amp rated cur, 2.87 kva; varied by handwheel; impr w/furane over wire; air cooled; open metal case; 7 screw and solder lug term mtd on side; three #10–32 tapped holes spaced 120° on 1¾" rad; impr for tropical use; GR #V–5H.	Rectifier filament voltage control.	2Z9957–37
V301 through V306	TUBE, electron: JAN–575A; diode	High-voltage rectifier tubes	2J575A
	TRANSMISSION LINE KIT		
	INSULATOR, feedthru: c/o steatite grade L5 white glazed bowl, bushing, supplied w/six ¼"-20 x 1½" lg RH brass nickel pl machine screws; ea w/2 flat washers and 1 spring washer and one ¼"-20 x $\frac{7}{16}$" hex brass nickel pl nut; 1 antenna bowl gasket for mtg; feedthru stud mtd to bowl w/1 bakelite flat washer, 1 brass nickel pl flat washer and 1 lock washer and one ½"–13 x ⅞" hex brass nickel pl nut; top of stud has ¼"–20 x ½" hex head bolt brass nickel pl; bottom of stud has ¼"–20 x ⅝" lg round hd brass nickel pl machine screw; Rad Receptor dwg #B–431–719.	Insulator on transmitter house for transmission line	3G290–31
	TRANSMISSION LINE KIT: c/o the following items:	For transmission line	2Z10009–47
	a three 360-ft lengths #10 solid copperweld wire, Rad Receptor dwg #A–431–617.		1A810.21
	b one 240-ft length #6 solid copperweld wire, Rad Receptor dwg #A–431–622.		1A806.14
	c one 50-ft length #14 soft drawn bare copper wire, Rad Receptor dwg #A–431–623.		1A814.17
	d 35 spreader insulators, round post shape; grade L4 white glazed ceramic; 10½" lg o/a x 1" diam; 3 grooves 5" apart, ea ⅛" wd x $\frac{7}{16}$" d; Rad Receptor dwg #B–431–702.		3G340–6
	e 12 transmission line support assem, Rad Receptor dwg #D–431–618.		2Z9057–48
	f 12 ground rods, copperweld; 72" lg x ⅝" diam; conepoint; clamp connected; Hubbard #9436, Rad Receptor dwg #A–431–620.		5B4401–6
	g 13 ground wire clamps, cast bronze; $1\frac{5}{16}$" x 1½" x ⅞" o/a; one ½"–13 x ⅝" lg Allen head set screw; Hubbard #9492; Rad Receptor dwg #A–431–619.		5B3392
	h 100 staples, Hubbard #7654, Rad Receptor dwg #A–431–621.		5B17000–1.2
	i 30 copper steel gimlet-point lagscrews, sq head; ⅜" diam x 1½" lg; Rad Receptor dwg #A–431–627.		6L5106–1.58
	j 2 Allen wrenches ¼" hex; 3¼" lg x 1⅛" wd x ¼" across flats; alloy steel, cad pl; L-shaped; Allen Mfg #¼; Rad Receptor dwg #A–431–624.		6L57400–3

[AG 300.7 (14 Jun 51)]

BY ORDER OF THE SECRETARY OF THE ARMY:

OFFICIAL:
WM. E. BERGIN
Major General, USA
Acting The Adjutant General

J. LAWTON COLLINS
Chief of Staff, United States Army

DISTRIBUTION:
Army:
Tech Svc (2) except 11 (65); Arm & Svc Bd (1); AFF Bd (ea Svc Test Sec) (1); AFF (5); AA Comd (2); OS Maj Comd (5); Base Comd (5); MDW (5); Log Comd (2); A (20); CHQ (2); FC (2); Sch (2) except 11 (25); Gen Dep (2); Dep 11 (20) except Sig Sec, Gen Dep (10); Tng Div (2); PE (10), OSD (2); Lab 11 (5); 4th & 5th Ech Maint Shops 11 (3); Two (2) copies to each of the following T/O & E's: 11–107; 11–127; 11–500 CA, CB, CC, CD; 11–587; 11–592; 11–597; SPECIAL DISTRIBUTION.

For explanation of distribution formula, see SR 310–90–1.

☆U. S. GOVERNMENT PRINTING OFFICE: 1951—957021 1003A

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

TM 11-5028

AMPLIFIER ASSEMBLY AN/FRA-1A

DEPARTMENT OF THE ARMY • NOVEMBER 1948

United States Government Printing Office

Washington : 1948

DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *10 November 1948*

TM 11–5028, Amplifier Assembly AN/FRA–1A, is published for the information and guidance of all concerned.

[AG 300.7 (29 Oct 48)]

BY ORDER OF THE SECRETARY OF THE ARMY:

OMAR N. BRADLEY
Chief of Staff, United States Army

OFFICIAL:
EDWARD F. WITSELL
Major General
The Adjutant General

DISTRIBUTION:

Army:

Tech Sv (2); Arm & Sv Bd (1); AFF Bd (ea Sv Test Sec) (1); AFF (5); OS Maj Comd (5); Base Comd (3); MDW (5); A (ZI) (20), (Overseas) (5); CHQ (2); FC (2); USMA (2); Sch 11 (10); Gen Dep (10); Dep 11 (5) except Baltimore & Sacramento (20); Tng Ctr (2); PE (10); Lab 11 (2); 4th & 5th Ech Maint Shops 11 (2); T/O&E 11–47 (2); 11–107 (2); 11–127 (2); 11–587 (2); 11–592 (2); 11–597 (2); SPECIAL DISTRIBUTION.

Air Force:

USAF (5); USAF Maj Comd (5); USAF Sub Comd (3); Services (MATS) (2); Class III Instls (2); SPECIAL DISTRIBUTION.

For explanation of distribution formula see TM 38–405.

CONTENTS

		Paragraph	Page
Part One. Introduction.			
Section I.	General.		
	Scope of manual	1	1
	Forms and records	2	1
II.	Description and data.		
	General	3	1
	Identification of major components	4	1
	Brief description	5	1
	Material not supplied	6	1
	Differences in models	7	1
	Technical characteristics	8	6
	Table of components	9	6
	Packaging data	10	6
	Auxiliary material	11	7
	Running spare parts	12	8
	Antenna systems	13	10
Part Two. Operating Instructions.			
Section III.	Service upon receipt of equipment.		
	New equipment	14	11
	Reconditioned equipment	15	11
	General information on unpacking	16	11
	Specific instructions on unpacking	17	11
	Siting	18	13
	Installation of equipment in transmitter house	19	14
	Installation of antenna tuning unit	20	23
IV.	Controls and initial adjustments.		
	Knowledge of theory of operation required	21	35
	Controls and instruments on amplifier and rectifier	22	35
	Controls and instruments on antenna tuning unit	23	37
	Controls and instruments on exciter	24	38
	Preliminary adjustments	25	38
	Practice with control circuit	26	39
V.	Tuning procedure.		
	Exciter tuning	27	42
	Amplifier tuning	28	44
	Antenna tuning unit tuning	29	46
VI.	Operation under unusual conditions.		
	Equipment failure	30	52
	Unusual temperature	31	52
Part Three. Maintenance Instructions.			
Section VII.	Special organizational tools and equipment.		
VIII.	Lubricants.		
IX.	Preventive maintenance services.		
	Periodic service on Amplifier Assembly AN/FRA–1A	32	53
	Weatherproofing	33	54
Part Four. Equipment Used in Conjunction with Amplifier Assembly AN/FRA–1A.			
	Radio Transmitter BC–365–( )	34	56
Part Five. Technical Service Maintenance Instructions.			
Section X.	General.		
	General	35	57
XI.	Theory of operation.		
	Radio-frequency circuits	36	57
	Power circuits	37	59
	Control circuits	38	60
	Miscellaneous protection	39	62

Part Five. Technical Service Maintenance Instructions—Continued

	Paragraph	Page
Section XII. Prerepair procedures.		
Test and repair equipment	40	62
Inspection, cleaning, and lubricating	41	63
Stripping	42	63
XIII. Trouble location.		
Preliminary procedure	43	69
Sectionalizing trouble	44	69
Localizing trouble	45	70
Apparatus adjustment	46	72
Repairs	47	72
Appendix I. Shipment and Storage		83
Appendix II. References		84
Appendix III. Identification Table of Replaceable Parts		85

WARNING

HIGH VOLTAGE

is used in the operation of this equipment.

DEATH ON CONTACT

may result if operating personnel fail to observe safety precautions.

SAFETY NOTICE

Amplifier Assembly AN/FRA–1A uses extremely high voltages which are dangerous to life.

Do not rely on the safety interlocks with which this equipment is provided; be sure voltage is off. Do not rely on the bleeder resistors to discharge high-voltage capacitors; use the grounding hook.

Dangerous r-f voltages are developed in the transmitter and antenna tuning unit.

USE EXTREME CAUTION

DEMOLITION TO PREVENT ENEMY USE

WHY— To prevent the enemy from using or salvaging this equipment.
WHEN—When ordered by your commander.
HOW— 1. Smash—Use sledges, axes, handaxes, pickaxes, hammers, crowbars, heavy tools.
2. Cut—Use axes, handaxes, machetes.
3. Burn—Use gasoline, kerosene, oil, flame throwers, incendiary grenades.
4. Explosives—Use firearms, grenades, TNT.
5. Disposal—Bury in slit trenches, fox holes, other holes. Throw in streams. Scatter.

USE ANYTHING IMMEDIATELY AVAILABLE FOR DESTRUCTION OF THIS EQUIPMENT

WHAT—1. Smash—All panels, controls, switches, connections; every electrical or mechanical part.
2. Cut—All wiring, interconnections.
3. Burn—All technical manuals, literature, etc.
4. Bend—Chassis; obliterate all identifying marks; destroy nameplates and circuit labels.
5. Bury or scatter—All debris.

DESTROY EVERYTHING

RESCUE.

In case of electric shock, shut off the high voltage at once and ground the circuits. If the high voltage cannot be turned off without delay, free the victim from contact with the live conductor as promptly as possible. Avoid direct contact with either the live conductor or the victim's body. Use a dry board, dry clothing, or other nonconductor to free the victim. An ax may be used to cut the high-voltage wire. Use extreme caution to avoid the resulting electric flash.

SYMPTOMS.

a. Breathing stops abruptly in electric shock if the current passes through the breathing center at the base of the brain. If the shock has not been too severe, the breath center recovers after a while and normal breathing is resumed, provided that a sufficient supply of air has been furnished meanwhile by artificial respiration.

b. The victim is usually very white or blue. The pulse is very weak or entirely absent and unconsciousness is complete. Burns are usually present. The victim's body may become rigid or stiff in a very few minutes. This condition is due to the action of electricity and is not to be considered rigor mortis. Artificial respiration must still be given, as several such cases are reported to have recovered. The ordinary and general tests for death should never be accepted.

TREATMENT.

a. Start artificial respiration immediately. At the same time send for a medical officer, if assistance is available. Do not leave the victim unattended. Perform artificial respiration at the scene of the accident, unless the victim's or operator's life is endangered from such action. *In this case only*, remove the victim to another location, but no farther than is necessary for safety. If the new location is more than a few feet away, artificial respiration should be given while the victim is being moved. If the method of transportation prohibits the use of the Shaeffer prone pressure method, other methods of resuscitation may be used. Pressure may be exerted on the front of the victim's diaphragm, or the direct mouth-to-mouth method may be used. Artificial respiration, once started, must be continued, without loss of rhythm.

b. Lay the victim in a prone position, one arm extended directly overhead, and the other arm bent at the elbow so that the back of the hand supports the head. The face should be turned away from the bent elbow so that the nose and mouth are free for breathing.

c. Open the victim's mouth and remove any foreign bodies, such as false teeth, chewing gum, or tobacco. The mouth should remain open, with the tongue extended. Do not permit the victim to draw his tongue back into his mouth or throat.

d. If an assistant is available during resuscitation, he should loosen any tight clothing to permit free circulation of blood and to prevent restriction of breathing. He should see that the victim is kept warm, by applying blankets or other covering, or by applying hot rocks or bricks wrapped in cloth or paper to prevent injury to the victim. The assistant should also be ever watchful to see that the victim does not swallow his tongue. He should continually wipe from the victim's mouth any frothy mucus or saliva that may collect and interfere with respiration.

e. The resuscitating operator should straddle the victim's thighs, or one leg, in such manner that:

(*1*) the operator's arms and thighs will be vertical while applying pressure on the small of the victim's back;

(*2*) the operator's fingers are in a natural position on the victim's back with the little finger lying on the last rib;

(*3*) the heels of the hands rest on either side of the spine as far apart as convenient without allowing the hands to slip off the victim;

(*4*) the operator's elbows are straight and locked.

f. The resuscitation procedure is as follows:

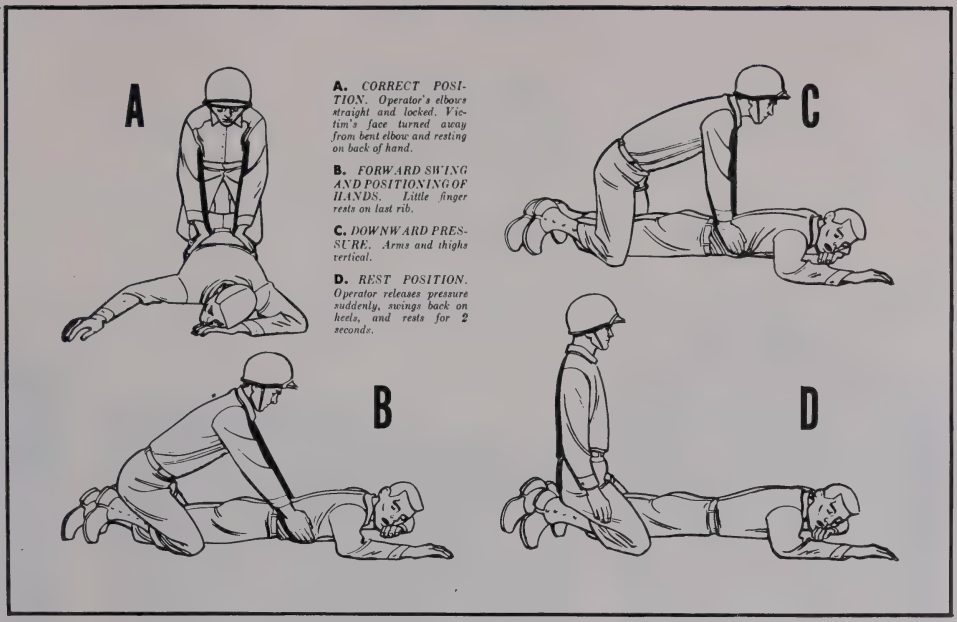
(*1*) Exert downward pressure, not exceeding 60 pounds, for 1 second.

(*2*) Swing back, suddenly releasing pressure, and sit on the heels.

(*3*) After 2 seconds rest, swing forward again, positioning the hands exactly as before, and apply pressure for another second.

g. The forward swing, positioning of the hands, and the downward pressure should be accomplished in one continuous motion, which requires 1 second. The release and backward swing require 1 second. The addition of the 2-second rest makes a total of 4

TL15338-D



A. *CORRECT POSITION. Operator's elbows straight and locked. Victim's face turned away from bent elbow and resting on back of hand.*

B. *FORWARD SWING AND POSITIONING OF HANDS. Little finger rests on last rib.*

C. *DOWNWARD PRESSURE. Arms and thighs vertical.*

D. *REST POSITION. Operator releases pressure suddenly, swings back on heels, and rests for 2 seconds.*

seconds for a complete cycle. Until the operator is thoroughly familiar with the correct cadence of the cycle, he should count the seconds aloud, speaking distinctly and counting evenly in thousands. Example: one thousand and one, one thousand and two, etc.

h. Artificial respiration should be continued until the victim regains normal breathing or is pronounced dead by a medical officer. Since it may be necessary to continue resuscitation for several hours, relief operators should be used if available.

RELIEVING OPERATOR.

The relief operator kneels beside the operator and follows him through several complete cycles. When the relief operator is sure he has the correct rhythm, he places his hands on the operator's hands without applying pressure. This indicates that he is ready to take over. On the backward swing, the operator moves and the relief operator takes his position. The relieved operator follows through several complete cycles to be sure that the new operator has the correct rhythm. He remains alert to take over instantly if the new operator falters or hesitates on the cycle.

STIMULANTS.

a. If an inhalant stimulant is used, such as aromatic spirits of ammonia, the individual administering the stimulant should first test it himself to see how close he can hold the inhalant to his own nostril for comfortable breathing. Be sure that the inhalant is not held any closer to the victim's nostrils, and then for only 1 or 2 seconds every minute.

b. After the victim has regained consciousness, he may be given hot coffee, hot tea, or a glass of water containing ½ teaspoon of aromatic spirits of ammonia. *Do not give any liquids to an unconscious victim.*

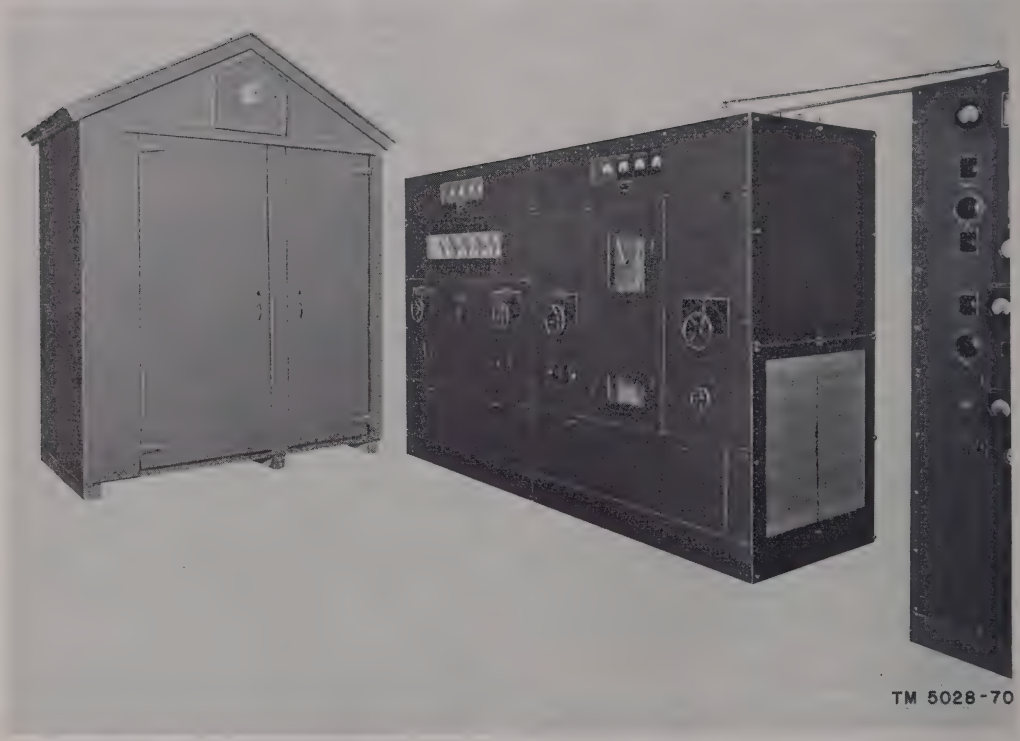
CAUTIONS.

a. After the victim revives, keep him LYING QUIETLY. Any injury a person may have received may cause a condition of shock. Shock is present if the victim is pale and has a cold sweat, his pulse is weak and rapid, and his breathing is short and gasping.

b. Keep the victim lying flat on his back, with his head lower than the rest of his body and his hips elevated. Be sure that there is no tight clothing to restrict the free circulation of blood or hinder natural breathing. Keep him warm and quiet.

c. A resuscitated victim must be watched carefully as he may suddenly stop breathing. *Never leave a resuscitated person alone until it is CERTAIN that he is fully conscious and breathing normally.*

TL15338-E



Amplifier Assembly AN/FRA-1A.

PART ONE
INTRODUCTION

Section I. GENERAL

1. Scope of Manual

This manual includes information required to install, operate, and maintain Amplifier Assembly AN/FRA–1A.

2. Forms and Records

a. WD AGO Form 468 (War Department Unsatisfactory Equipment Report) for Equipment Used by the Army. WD AGO Form 468 will be filled out and forwarded through channels to the Office of the Chief Signal Officer, Washington 25, D. C., when trouble occurs more often than is normal, as determined by qualified repair personnel.

b. AF Form 54 (Unsatisfactory Report) for Equipment Used by the Air Force. AF Form 54 will be filled out and forwarded to Commanding General, Air Matériel Command, Wright-Patterson Air Force Base, Dayton, Ohio, in accordance with AF Regulation 15–54.

Section II. DESCRIPTION AND DATA

3. General

Amplifier Assembly AN/FRA–1A is intended for fixed military radiotelegraph service as a 6- to 10-kw (kilowatt) amplifier used in conjunction with 350-watt, 150- to 550-kc (kilocycle) Radio Transmitter BC–365–( ) as exciter. TM 11–828, Radio Transmitter BC–365–F and Remote Control Unit RM–10–F, covers this radio transmitter. The equipment is intended for installation in a transmitter house provided with means for keeping the room temperature within 15° C. to 50° C. (59° F. to 122° F.).

4. Identification of Major Components

Amplifier Assembly AN/FRA–1A consists of an amplifier (fig. 1), a rectifier unit (fig. 2), and an antenna tuning unit (fig. 3). A kit of transmission line materials (fig. 4) is supplied with the equipment for connecting between the amplifier and the antenna tuning unit. A kit of vacuum tubes and running spare parts and tubes is also supplied.

5. Brief Description

The amplifier and the rectifier unit of Amplifier Assembly AN/FRA–1A are conventionally designed aluminum frame-and-panel structures of the same size and shape. The frames are bolted together at the installation to make an integral assembly. The antenna tuning unit consists of a prefabricated wooden house containing the antenna tuning networks.

6. Material Not Supplied

The following material required for installation is *not* supplied as part of Amplifier Assembly AN/FRA–1: exciter, Radio Transmitter BC–365–( ); foundation posts for antenna tuning unit house; antenna; heating and cooling equipment for transmitter house; feed-through insulators for passing transmission line through the wall of the transmitter house; and transmission line poles. See paragraph 11 for complete description of necessary auxiliary material.

7. Differences in Models

A similar equipment, Amplifier Assembly AN/FRA–1, has been supplied under the commercial nomenclature 6–KW R–F Amplifier PA–1A, Rectifier RA–1A and Antenna Tuning Unit AT–1A, and is covered in TM 11–1055. Amplifier Assembly AN/FRA–1A is similar in external appearance and size and is functionally identical with the corresponding units PA–1A, RA–1A, and AT–1A. However, there are minor differences in the location of controls and control circuit wiring in the two equipments.

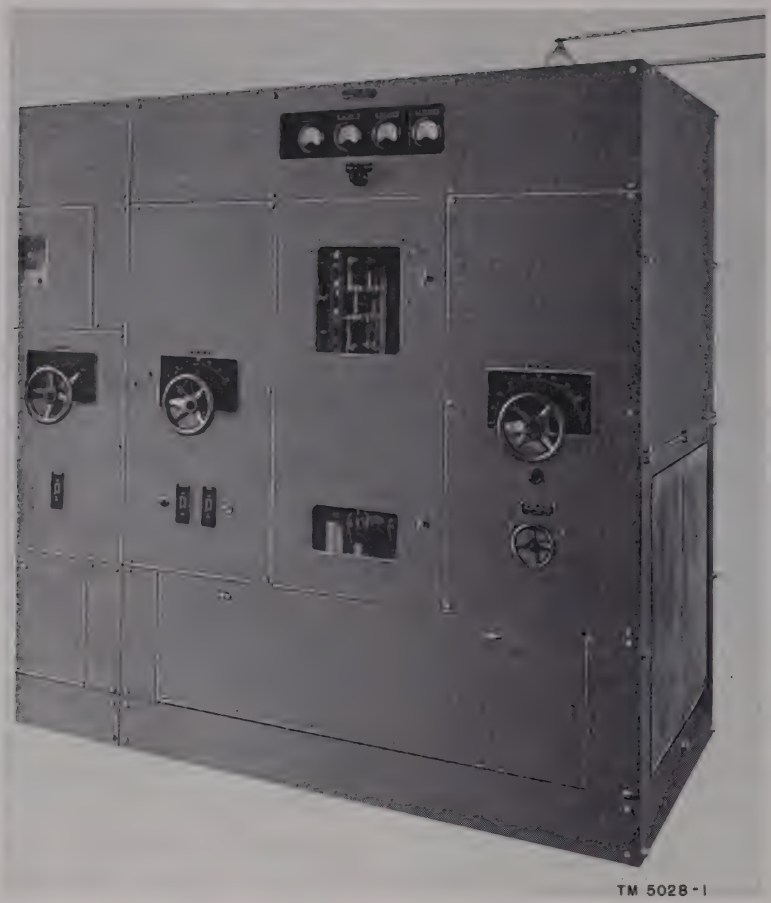


Figure 1. Amplifier of Amplifier Assembly AN/FRA–1A.

Figure 2. Rectifier unit of Amplifier Assembly AN/FRA–1A.

Figure 3. Antenna tuning unit of Amplifier Assembly AN/FRA–1A.

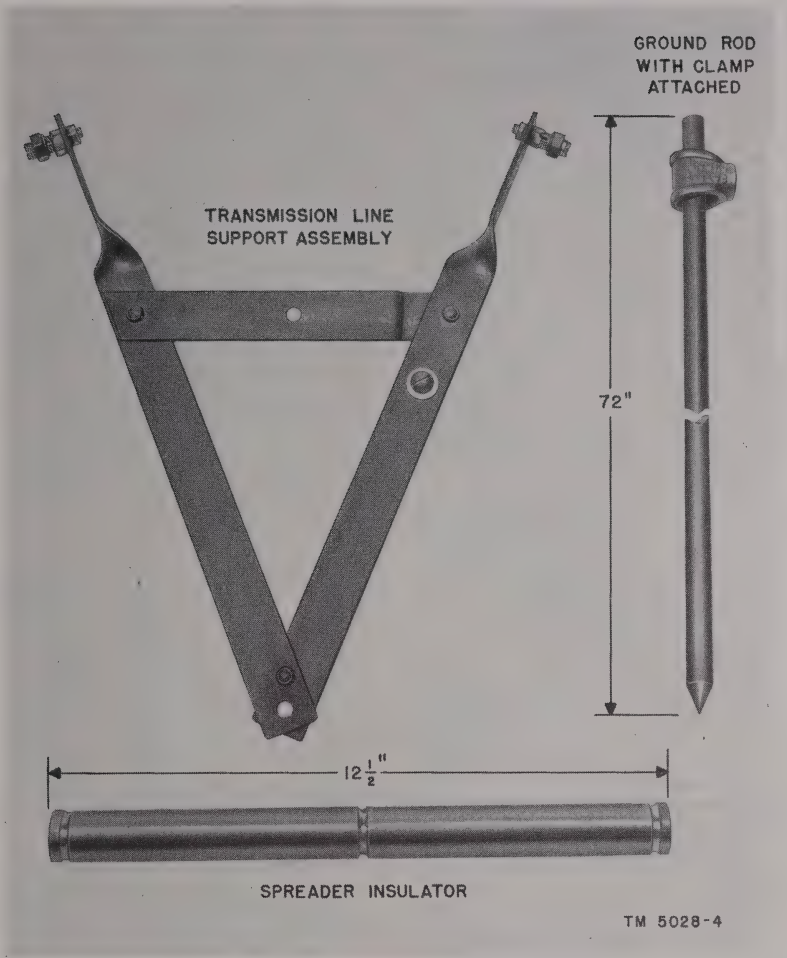


Figure 4. Partial components of transmission line kit.

8. Technical Characteristics

Frequency range	150 to 550 kc, continuously tunable
Type of emission	Radiotelegraphy, on-off or frequency shift keying up to 200 words per minute using five-letter International Morse characters.
Excitation requirements.	300 watts rf (radio frequency) Transmitter BC–365–( ).
Power output	A minimum power output of 6 kw is obtained when the amplifier is connected to an antenna of 750 mmf (micromicrofarads) capacity and 6 ohms resistance at 150 kc; output power up to 10 kw can be obtained into antennas of higher capacity and resistance at higher frequencies.
Transmission line	Surge impedance 350 ohms; three-wire open line; No. 10 AWG conductors spaced on 6-inch centers, outer wires grounded.
Antenna characteristics.	750 to 3,000 mmf capacity, 6 to 12 ohms resistance over the frequency range 150 to 550 kc (par. 13).
Tube complement	1 Tube—JAN–891R, Amplifier. 6 Tubes—JAN–575A, plate rectifiers. 2 Tubes—JAN–866A/866, bias rectifiers.
Power requirements.	At full load, 200/240 volts, 50/60 cps (cycles per second), three-phase, 22 kva (kilovolt-ampere) at 90 percent power factor; current distribution at 200 volts, 60 cps: Line 1—54 amp (ampere). Line 2—63 amp. Line 3—58 amp.
Emergency operation.	A network with suitable switching is provided to match the output of Radio Transmitter BC–365–( ) directly to the transmission line in the event of failure of the amplifier assembly.
Installation space	19 feet by 5 feet floor space by 7 feet ceiling height inside transmitter house; 9 feet by 7 feet clear area adjacent to antenna down-lead.

9. Table of Components

Major component	Dimensions (in.)			Weight (lb.)
	Height	Width	Depth	
Amplifier (fig. 1)	76	60	36	900
Rectifier unit (fig. 2)	76	60	36	2, 000
Antenna tuning unit (fig. 3)	98	84	58	1, 400

Minor component	Description
Transmission line kit (fig. 4).	Consists of spreader insulators, line support assemblies, ground rods, spools of wire, and sundry hardware; packed in bulk.
Running spare parts kit.	Consists of capacitors, resistors, meters, relay coils and contacts, vacuum tubes, and indicator lamps.

Note. This list is for general information only. See appropriate publications for information pertaining to the requisition of spare parts.

10. Packaging Data

a. Case Dimensions and Weights

Case No.	Dimensions (in.)			Weight (lb)
	Height	Width	Depth	
1	86	68	42	1, 200
2	86	68	42	1, 200
3	88	83	30	1, 400
4	78	30	48	300
5	80	30	30	275
6	24	36	36	275
7	42	25	21	75
8	48	24	24	400
9	48	24	24	400
10	48	24	24	400
11	40	28	20	100
12	40	28	20	100
13	40	28	20	100
Total weight				6, 225

b. Case Contents.

Note. This list is not complete; it gives only the general contents of each case. For the exact contents see the packing list attached to each case. For specific unpacking instructions see paragraph 17.

Case No.	Contents	Notes
1	1 Amplifier	Less tubes and indicator lamps; includes hardware for bolting to rectifier unit.
	1 Ground hook	Packed inside amplifier.
	2 Copper tubing bus leads	Packed inside amplifier.
2	1 Rectifier unit	Less tubes, indicator lamps, and plate transformers; includes interconnecting cables.
	1 Set of tubes and indicating lamps, except amplifier Tube JAN–891R (V–201).	Packed inside rectifier unit.
	1 Transmission line kit, less ground rods.	Packed inside rectifier unit.
	6 Copper tubing bus leads	Packed inside rectifier unit.
3	1 Prefabricated house for antenna tuning unit.	Less antenna and transmission line insulator board assemblies; includes assembly and and foundation hardware.
4	1 Main subassembly for antenna tuning unit, consisting of variable inductors, meters, switches, and control panel.	Includes hardware for assembly to house. (See fig. 5.)
	1 Horn gap subassembly for antenna tuning unit.	Includes hardware for assembly to house. (See fig. 6.)
	1 Antenna insulator board subassembly.	Part of antenna tuning unit. (See fig. 7.)
	1 Transmission line insulator board subassembly.	Part of antenna tuning unit. (See fig. 8.)
5	1 Antenna loading coil for antenna tuning unit.	Includes hardware for assembly to house. (See fig. 9.)
	1 Set of ground rods	Part of transmission line kit.
6	1 Kit of running spare parts.	Less tubes and indicator lamps.
	2 Technical manuals	TM 11–5028.
7	1 Kit of running spare tubes and indicating lamps.	Less Tube JAN–891R (V–201).
8	*Plate transformer for rectifier unit.	(See fig. 10.)
9	*1 Plate transformer for rectifier unit.	
10	*1 Plate transformer for rectifier unit.	
11	**1 Tube JAN–891R for amplifier assembly.	(See fig. 11.)
12	**1 Tube JAN–891R for amplifier assembly.	(Running spare.)
13	**1 Tube JAN–891R for amplifier assembly.)	(Running spare.)

*Heavy oil-filled units. Avoid dropping.

**Large forced-air tube packed in standard spring-suspension case. Tube should remain in case until used. Case and clamping hardware should be stored for reshipment when tube is replaced.

11. Auxiliary Material

The material described in this paragraph is required for a complete installation of Amplifier Assembly AN/FRA–1A but is not supplied with this equipment.

a. Radio Transmitter BC–365–( ). Any model of Radio Transmitter BC–365–( ) and associated Remote Control Unit RM–10–( ) will operate with Amplifier Assembly AN/FRA–1A. TM 11–828 describes this equipment.

b. Antenna System. For suitable antenna systems see paragraph 13.

c. Foundation Posts for Antenna Tuning Unit. Six wooden foundation posts are required. They may be round, square, or rectangular in cross-section. The required dimensions are: diameter or on a side, 10 to 12 inches; length, at least 2 feet plus the depth of the frost level at the site. The wood should be treated with preservative.

d. Transmission Line Poles. A maximum of 12 wooden transmission line poles is required. They may be either round or square in cross-section. The required dimensions are: diameter or on a side, 5 inches; length, at least 10 feet plus the depth of the frost level. The wood should be treated with preservative.

e. Wood Preservative and Brush. A quart of wood preservative and a 3-inch brush are required for touching up posts and poles after installation.

f. Feed-Through Insulator for Transmitter House. Means for bringing the three-wire transmission line through the wall of the transmitter house should be provided. The center conductor feed-through insulator must be rated for 15,000 volts peak. The outer conductors are at ground

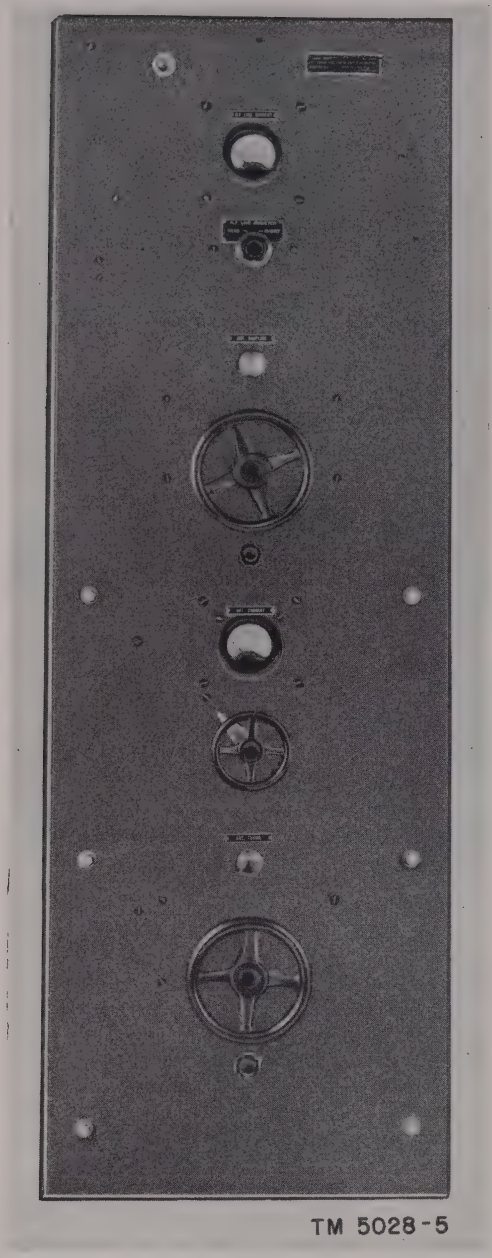


Figure 5. Main subassembly for antenna tuning unit.

potential and need not be insulated. The outer conductors are spaced 6 inches on either side of the center conductor along a horizontal center line. All three conductors are No. 10 AWG bare copper-weld wire.

g. Cable Duct for Transmitter House. An underfloor cable duct should be provided in the transmitter house. This will contain the power cable and the control cable between the units.

h. Air Conditioning for Transmitter House. Means for maintaining the temperature inside the transmitter house between 15° C. and 50° C. (59° F. and 122° F.) should be provided.

i. Tools. A fairly complete assortment of hand tools is required for installation. Tool Equipment TE–87–A contains most of the necessary tools. Minimum requirements are as follows:

(1) Assorted screw drivers.
(2) Open-end wrenches, up to 1¼-inch opening.
(3) Socket wrenches, with offset ratchet handle, up to 1¼-inch hexagonal.
(4) Electrician's pliers.
(5) Nail-puller.
(6) Hammer.
(7) Center punch.
(8) Hand drill, ¼-inch chuck capacity.
(9) No. 35, No. 8, and ¼-inch diameter twist drills.
(10) Carpenter's brace, heavy-duty, ratchet type.
(11) Wood auger bit, 1¼ inches diameter by 12 inches long minimum.
(12) Post-hole digger.
(13) Shovel.
(14) Wood saw, heavy-duty cross-cut.
(15) Wood rasp, large.
(16) 50-foot steel tape.
(17) 2-foot carpenter's level.
(18) 6-foot ladder, self-standing.
(19) Bench vise.
(20) Hack saw.
(21) Assortment of small files.
(22) Insulating tape.

12. Running Spare Parts

The following are supplied:

50 percent of the number in use of each different capacitor, meter, and resistor.
2 sets of contacts for each different relay.
1 coil for each different relay.

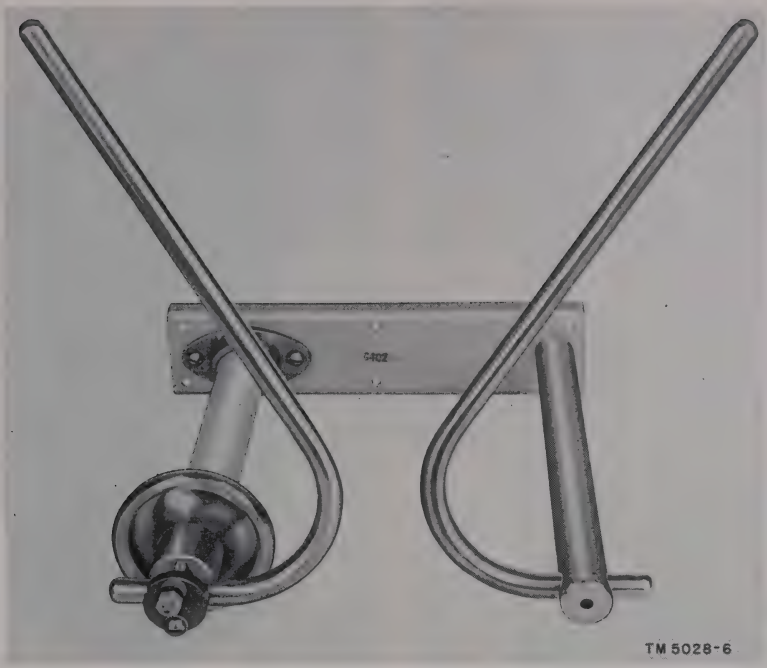


Figure 6. Horn gap subassembly G–402 for antenna tuning unit.

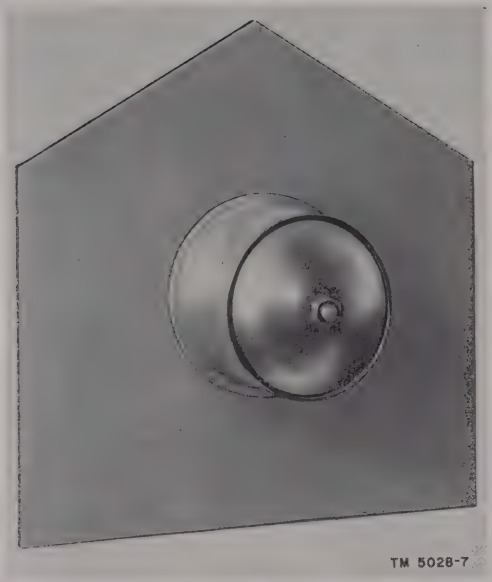


Figure 7. Antenna insulator board subassembly for antenna tuning unit.

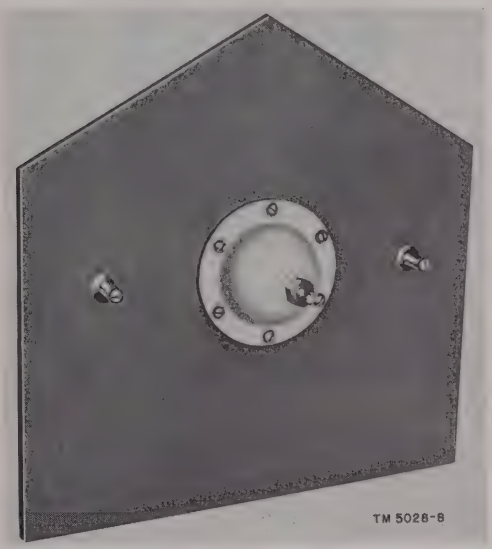


Figure 8. Transmission line insulator board subassembly for antenna tuning unit.

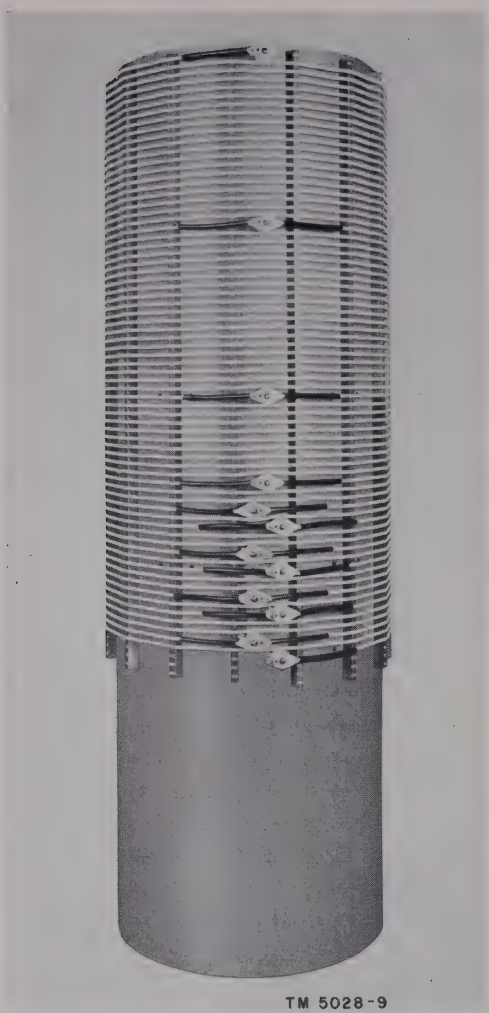


Figure 9. Antenna loading coil L–402 for antenna tuning unit.

2 sets of tubes.
6 sets of indicating lamps.
4 feet of fuse wire for F–401.

13. Antenna Systems

Any antenna system having the characteristics of 750 to 3,000 mmf capacity and 6 to 12 ohms resistance over the range 150 to 550 kc may be used. Suitable antennas are described below.

a. Antenna Tower AB–127/FR. Antenna Tower AB–127/FR is a 180-foot guyed steel tower

Figure 10. Plate transformer T–301, T–302, or T–303 for rectifier unit.

described in TM 11–5012, Antenna Tower AB–127/FR. The base of the tower is insulated and may be connected directly to the antenna terminal of Amplifier Assembly AN/FRA–1A.

b. Antenna Kit MX–765/FR. Antenna Kit MX–765/FR provides material for constructing an inverted L with counterpoise system and is described in TM 11–5010, Antenna Kit MX–765/FR. The horizontal leg of the inverted L consists of five parallel wires. The vertical leg is a single wire which may be connected directly to the antenna terminal of Amplifier Assembly AN/FRA–1A.

c. Antenna Assembly AS–334/FRT. Antenna Assembly AS–334/FRT is an aperiodic long-wire directional antenna (*wave* or *beverage* antenna). Its impedance is essentially 350 ohms resistive. When this antenna assembly is used with Amplifier Assembly AN/FRA–1A, the transmission line and antenna tuning unit are not required. The transmitting end of the antenna may be connected directly to the transmission line feed-through on the amplifier. No technical manual on Antenna Assembly AS–334/FRT is available at this time.

PART TWO

OPERATING INSTRUCTIONS

Note. The following terminology will be used in the remainder of this manual to indicate the major items of equipment:

Amplifier for Amplifier Assembly AN/FRA–1A	amplifier
Rectifier unit for Amplifier Assembly AN/FRA–1A	rectifier
Antenna tuning unit for Amplifier Assembly AN/FRA–1A	antenna tuning unit
Radio Transmitter BC–365–( )	exciter
Remote Control Unit RM–10–( )	remote control unit

Section III. SERVICE UPON RECEIPT OF EQUIPMENT

14. New Equipment

This section describes in detail the procedure for unpacking, installing, tuning, and operating new equipment. Ordinarily the equipment is operated by remote control from a message center or operating room. Under these circumstances the operator does not have direct surveillance of controls and instruments and is dependent on transmitter house personnel or monitoring stations to be assured of proper operation. Further, the tuning procedure for this equipment is a long and complicated job and generally is not performed often. Tuning should be done by experienced technicians. For these reasons, part two contains a section headed "TUNING PROCEDURE," as distinguished from solely operating instructions.

15. Reconditioned Equipment

As of the date of this manual, no reconditioned equipment of this identical design exists.

16. General Information on Unpacking

a. Form of Packing. (1) The major items are packed for oversea shipment in the general form shown in figure 12; variations are noted in the specific unpacking instructions (par. 17).

(2) The general rule in unpacking is stand case according to THIS SIDE UP marking; remove steel banding tape; using nail-puller, remove top and sides; then follow specific instructions.

b. Reminders. (1) Do not unpack anything except case No. 6 (in which this technical manual is packed) until the equipment is needed.

(2) If packing materials are to be saved for repacking, use care in removing moistureproof-vaporproof barriers. Remove them by slitting along the heat-sealed seams.

(3) Check contents of each case against the detailed packing list fastened to the case. Do not throw away any packing material until everything is accounted for.

17. Specific Instructions on Unpacking

Note. For contents of cases see paragraph 10*b*.

a. Case No. 1. (1) Strip the case and protective material until the amplifier is exposed. Leave the unit on the skid.

(2) Remove the upper right side panel and all rear panels, and open the bottom front door. Remove the short vertical front panels on both sides of the lower door and swing them out of the way.

(3) Using a rachet socket wrench, remove the nuts and washers from the bolts on the front and back edges of the bottom shelf. There are four nuts on each side, spaced equally from corner to corner.

(4) Tilt the unit forward and block up the rear skid about a foot, supporting the unit from the front. Then hammer out the bolts.

(5) Repeat the last step for removing the nuts from the front skid. After all eight bolts have been removed from the under side of the skids, allow the unit to sit flat on the floor on top of the skid.

(6) Tilt the unit and slide it off the skid. Avoid bouncing.

Figure 11. Tube JAN–891R, V–201, for amplifier, in packing case.

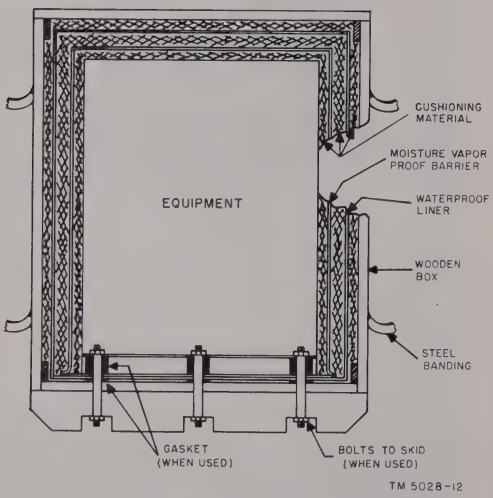


Figure 12. Cross-section of typical packing case.

(7) Find auxiliary items which are tied down in the middle section of the unit and check them off against the packing list.

(8) Remove the wood blocks from the blower, transformers, and capacitors. Untie loose leads, resistors, links, and working parts of the relays. Check *all* components for such packing aids.

(9) Inspect and feel for broken ceramics, loose shaft couplings, knobs, and loose parts in general.

b. Case No. 2. (1) Strip the case and protective material until the rectifier is exposed. Leave the unit on the skid.

(2) Remove the lower left side panel and all rear panels, and open the lower front door.

(3) Remove the vertical angle in the middle of the lower rear frame of the unit. Remove the small angle bracket which holds this angle to the bottom shelf.

(4) Remove the cartons of auxiliary material and bundles of bus tubing from the back of the unit. Check them off against the packing list.

(5) Proceed as in *a* (3) through *a* (9) above.

c. Case No. 3. (1) This is a simple closed crate with no other protective material.

(2) Lay crate flat, cut steel bands, and remove the top and sides of the crate.

(3) Inspect and check off the items against the packing list.

d. Case No. 4. (1) Strip the case and protective material. The unit is surrounded by an auxiliary crate.

(2) The auxiliary crate is not bolted to the skid; pick up the crate and the unit off the skid.

(3) Remove the two feed-through insulator boards from the top of the auxiliary crate; then strip off the auxiliary crate.

(4) Remove the horn gap from the middle shelf of the unit frame and find the bags of hardware. Check off all the items against the packing list.

(5) Remove the blocking and tying-down material. Carefully inspect all parts for such material.

(6) Inspect and feel for broken ceramics, loose shaft couplings, etc.

e. Case No. 5. (1) This case is similar to case No. 4. Follow the same unpacking procedure.

(2) Note the ground rods in the corners of the auxiliary frame and the bag of hardware tied to the coil.

f. Cases No. 6 and No. 7. (1) These cases are simply wooden boxes containing a cardboard carton of parts and tubes, with only a waterproof liner between the box and the carton.

(2) If no shelf or locker space is available for the contents of these cases, use the packing case as a locker. In this case, remove only the top of the case and slit open the carton. Do not remove moistureproof-vaporproof barrier from any item until the item is needed.

g. Cases No. 8, No. 9, and No. 10. (1) These cases each contain a plate transformer, with only a waterproof liner inside each case. Strip the case and demount from the skid.

(2) Find the bag of mounting hardware. Check for cracked insulators.

h. Cases No. 11, No. 12, and No. 13 (fig. 11).

(1) Remove the wood screws which hold down the hinged cover.

(2) Inspect each tube for broken glass or other damage.

(3) Do not unpack tubes until ready to use them. Handle the tube by the handles only. Replace the wooden clamping ring and hardware for future use.

18. Siting

a. Equipment in Transmitter House. Figure 13 shows a typical lay-out of the equipment in the transmitter house. Note that the transmission line may be run out at right angles to any side of the equipment.

b. Equipment in Field. Figure 14 is a typical field lay-out, showing the relation between the antenna, the antenna tuning unit house, and the equipment in the transmitter house. The transmission line kit contains enough material for a maximum of 300 feet. The antenna insulator on the tuning unit house should be close to the down lead of the antenna.

c. Outline Drawings. For an outline drawing of the antenna tuning unit, see figure 68; for

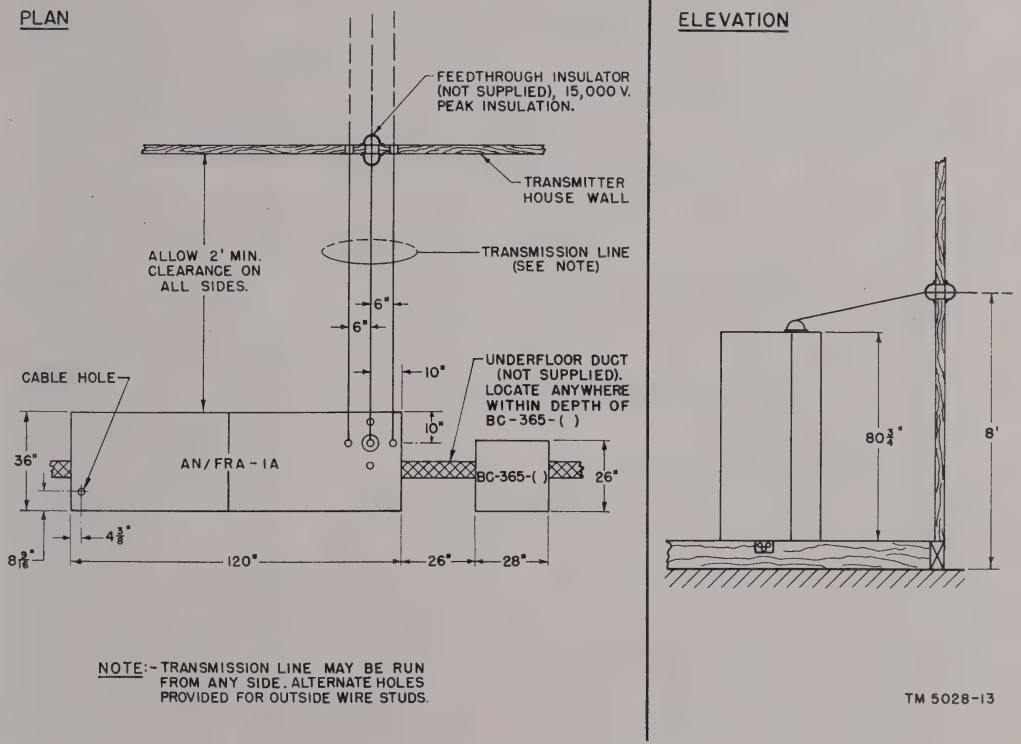


Figure 13. Lay-out plan in transmitter house.

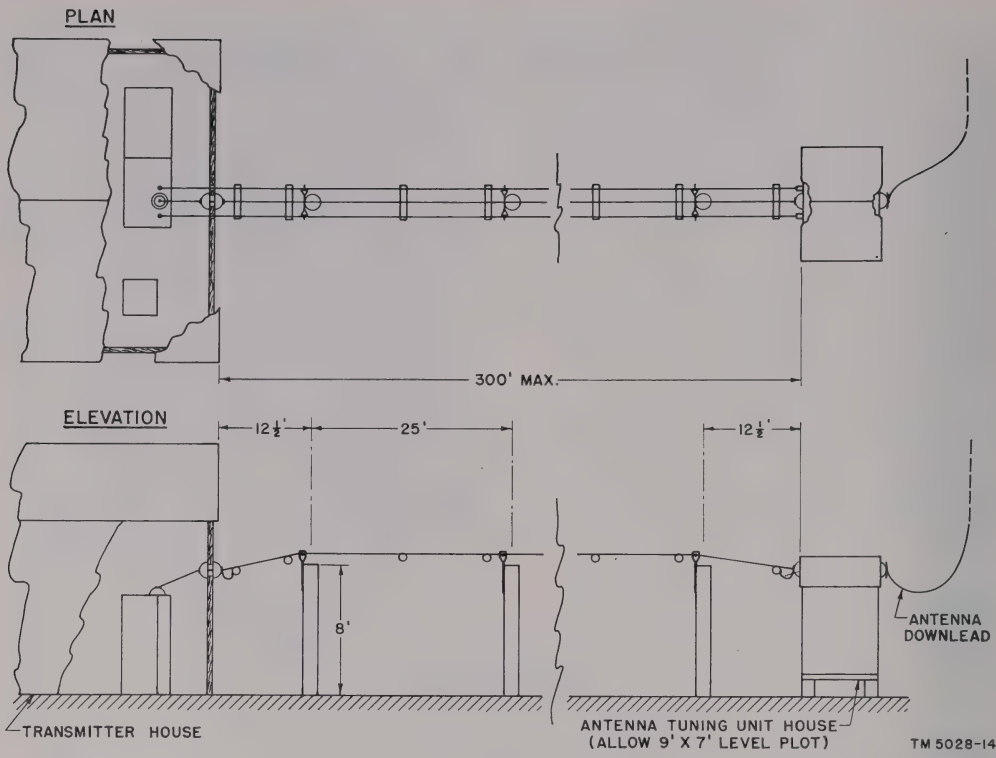


Figure 14. Lay-out plan for transmission line.

an outline drawing of the amplifier and rectifier, see figure 69.

19. Installation of Equipment in Transmitter House

a. Preparation of Underfloor Duct. Before moving the units into final position, prepare the underfloor duct as follows:

(1) Install the cable bushing in the duct 4 inches from the left-hand edge of the position determined for the rectifier. Figure 13 shows the position of the cable entry hole in the bottom of the rectifier.

(2) Install the cable bushing in the duct 4 inches from the right-hand edge of the position determined for the exciter.

(3) Install power cables for the rectifier and exciter, leaving about 2 feet of cable above the floor for trimming and maneuvering.

(4) Install interconnection cable (previously removed from input terminal board of rectifier) in the duct, leaving about 1½ feet of cable above the floor at the exciter end.

(5) Install remote-control cable for the exciter in the duct, leaving about 2½ feet of cable above the floor at the exciter duct bushing.

b. Placement of Amplifier. (1) The excitation feed-through insulator and the transmission line feed-through insulator and ground studs are inverted for shipment. Unmount these and remount them right side up. Then connect the bus leads to the feed-through studs inside. See figure 15 for the *before* and *after* appearances of these assemblies. Mount the transmission line ground studs in the holes which the particular lay-out requires. Observe tagging of bus leads and studs.

(2) Move the amplifier into position in accordance with the requirements of figure 13.

c. Placement of Rectifier. Move the rectifier into position alongside the amplifier before installing the plate transformers in the rectifier.

d. Bolting Amplifier and Rectifier Together. (1) Holes for bolting these units to-

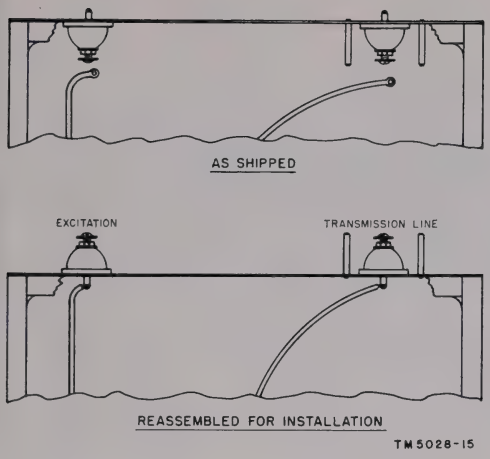


Figure 15. Reassembly of excitation and transmission line terminals.

gether are near the corners of each units, as shown in figure 16. Remove the adjacent top panels from each unit to permit access to the front upper holes. Access to the bottom front doors can be gained by opening the relay doors at the bottom of each unit.

(2) Using the hardware provided in the amplifier, bolt the units together. Shim up the units as required if the floor is not level. Bolting the units to the floor is not required.

(3) Replace the top panels.

e. Installation of Plate Transformers.

Note. Before installing transformers, check distance between spark gap balls on filter reactor L-301 (fig. 18). Adjust balls to ¼-inch spacing.

(1) Mount the three plate transformers on the bottom shelf of the rectifier. Observe that there are three groups of four holes each on the vacant half of the bottom shelf. These holes correspond

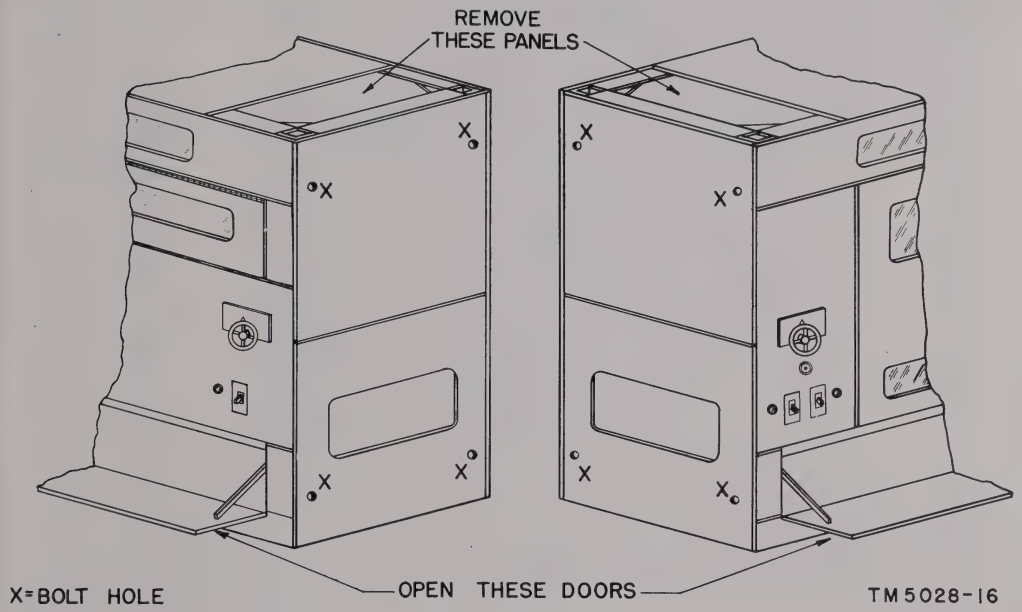


Figure 16. Location of holes for bolting amplifier and rectifier together.

to the mounting lugs on each transformer. The four primary terminals (small insulators) should face the back of the unit.

(2) If a hoist or lift truck is unavailable, place the wooden pallet base of the transformer packing case next to the rectifier. The transformers can then be jockeyed into place from the floor to the pallet, then from the pallet to the bottom shelf of the rectifier. Two men are required for this job.

(3) Bolt the transformers down, using the bag of hardware which is tied to each transformer.

(4) Make connections to the transformers according to figure 17. Use the jumper bus tagged "jumper T301–302–303 which was

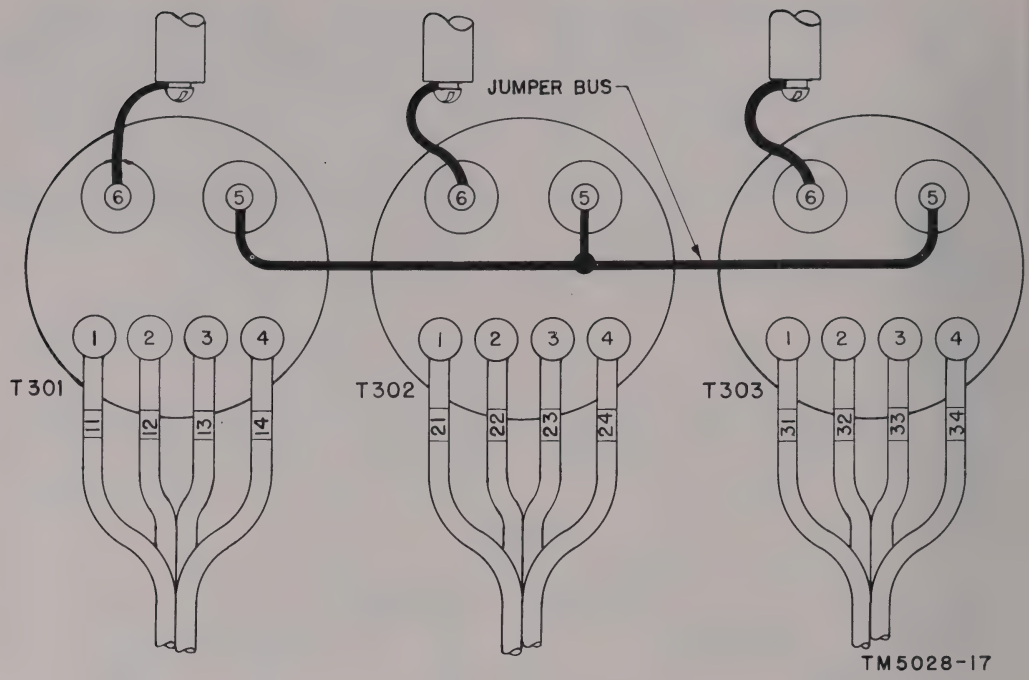


Figure 17. Connections to plate transformers.

removed from the unit when unpacking. The primary wires are tagged with the numbers shown. The three secondary wires come off the insulator posts adjacent to each transformer terminal and cannot be mixed up. Observe tagging.

(5) Replace the vertical angle which was removed from the back of the unit during unpacking (figs. 18 and 19).

f. Installation of Exciter. Install the exciter in the space determined according to figure 13. Set up the transmitter to operate on nominal 220-volt line. Follow the procedure given in TM 11–828, complete to the installation of tubes, for installation of the exciter and the remote control unit.

Note. The last three sentences of paragraph B2*b* in TM 11–828, which concern terminal numbers, do not apply when using Amplifier Assembly AN/FRA–1A.

g. Interconnections. (1) Facing the left side of the rectifier, locate the six terminals in the lower right-hand corner (fig. 20). Connect 220-volt, three-phase power line to terminals 1, 2, and 3.

(2) The three wires of the interconnection cable to the exciter are tagged 4, 5, and 6, respectively. Connect these wires to the correspondingly numbered terminals shown in figure 20.

(3) Connect 220-volt, single-phase power to terminals 5 and 6 on the exciter.

(4) Connect remote control line from the remote control unit to terminals 1, 2, and 3 on Radio Transmitter BC–365–( ).

(5) Facing the front of the amplifier and rectifier, open both lower doors, exposing the relay and terminal boards. A coiled-up 12-wire cable for interconnecting between the amplifier and rectifier will be found in the rectifier. All 12 wires will already have been connected to terminals 8 through 18 and terminal 20 on the rectifier. Uncoil the cable and pass it through the large hole between the units. The cable will just fit with all leads fanned out to the correspondingly numbered terminals on the amplifier. Hooks are provided behind the horizontal frame angles on the rectifier and on the amplifier. These can be found by reaching underneath. Hang the cable on these hooks. Connect the leads as shown in figure 21, observing the color coding. (If any doubt exists as to the color coding, note that like-numbered

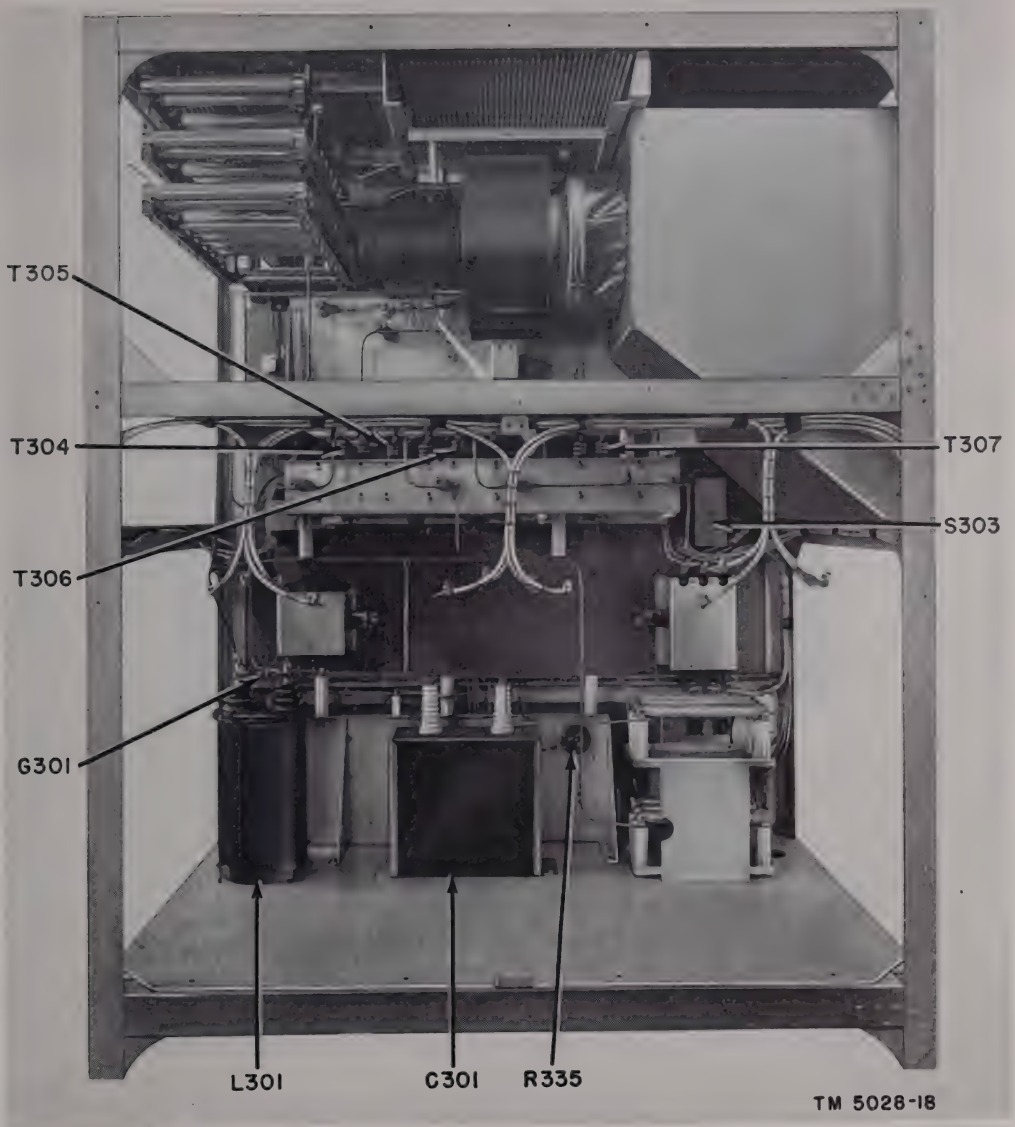


Figure 18. Rectifier unit, rear view, before installation of plate transformers and vertical angle.

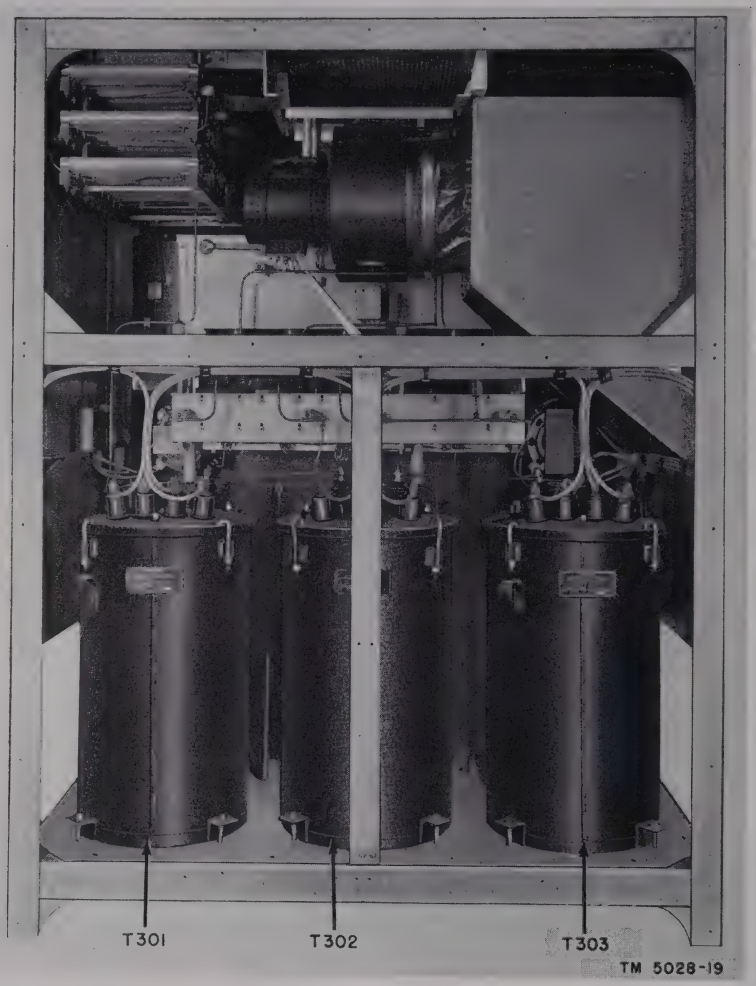


Figure 19. Rectifier unit, rear view, after installation of plate transformers and vertical angle.

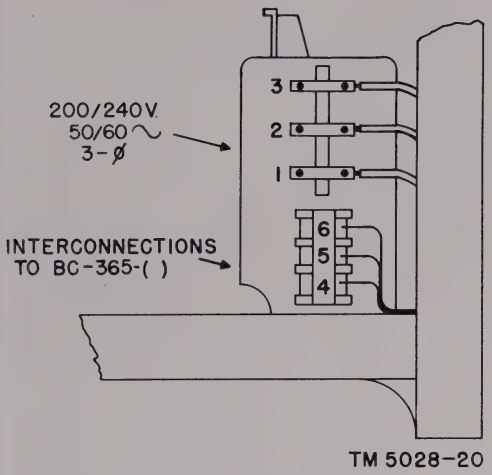
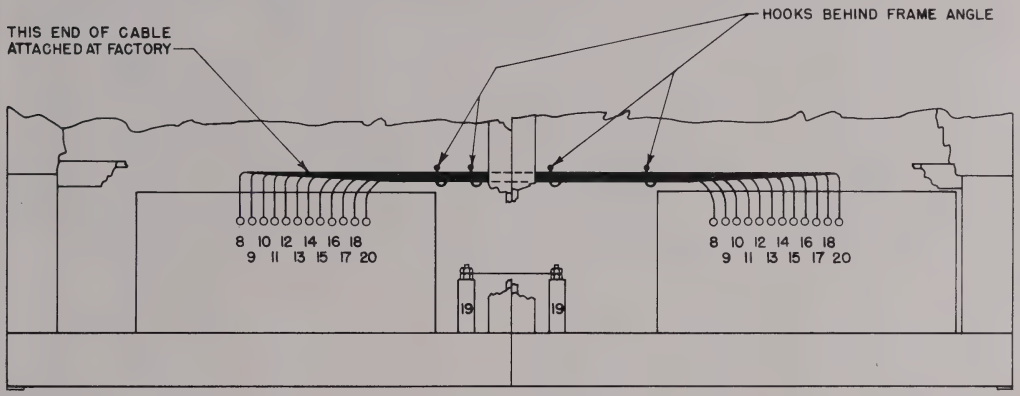


Figure 20. Rectifier input terminal board.

terminals on the rectifier and amplifier are to be connected together; check independently with ohmmeter or buzzer if required.) The high-voltage connection, terminal 19, is on an insulator post in the lower right-hand corner of the rectifier and on a similar insulator in the lower left-hand corner of the amplifier. Connect the wire on the rectifier insulator stud to the corresponding stud on the amplifier.

(6) Facing the right side of the exciter, open the door, exposing a panel at the bottom containing terminals, fuses, and relays. Referring to figure 22, remove the two wires connected to the left side coil terminal of relay RL–3. Carefully connect these two wires together, and tape them for protection. If only one wire is connected to the left coil terminal of relay RL–3, remove that wire and tape the exposed end. Connect wire No. 6 of the previously installed interconnection cable


THIS END OF CABLE
ATTACHED AT FACTORY
HOOKS BEHIND FRAME ANGLE
8 10 12 14 16 18
9 11 13 15 17 20
8 10 12 14 16 18
9 11 13 15 17 20
19
19

TERM. No.	TRACER	TERM. No.	TRACER
8	RED & BLUE (No. 18) *	14	NO TRACER
9	YELLOW & YELLOW	15	ORANGE
10	RED & BLUE (No. 14) *	16	ORANGE & YELLOW
11	BLUE	17	RED
12	RED & GREEN	18	RED & BLUE (No. 14) *
13	GREEN	20	BLACK

* No. 14 WIRE IS THICKER THAN No. 18. IF IN DOUBT ABOUT TRACER COLORS, NOTE THAT LIKE-NUMBERED TERMINALS ARE CONNECTED TOGETHER. CHECK WITH OHMMETER.

TM 5028-21

Figure 21. Interconnections between amplifier and rectifier.

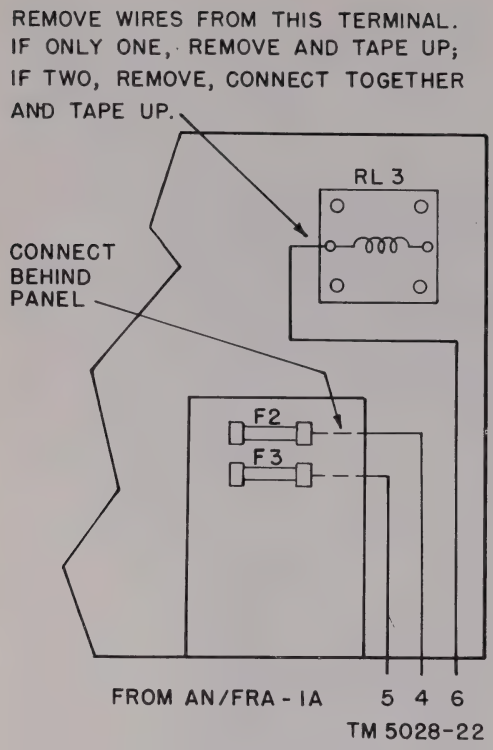


Figure 22. Interconnections to exciter.

to the vacant left coil terminal of relay RL–3. Connect wire No. 5 to the right-hand terminal (as viewed from the front of the panel) of fuse F–3. Similarly, connect wire No. 4 to the right-hand terminal of fuse F–2. Make these connections behind the panel to the studs holding the fuses.

(7) Two lengths of ⅜-inch diameter copper tubing bus were removed from the amplifier during unpacking. Referring to figure 23, attach the drilled end of one bus to the input feed-through insulator of the amplifier. Trim and flatten the copper tubing and drill a hole to attach the other end to the output feed-through insulator of the exciter. Similarly, use the other bus to make a ground connection between the nearest screws holding the top panels of either unit.

h. Installation of Tubes and Indicator Lamps. (1) Install a 6-watt, 120-volt pilot lamp in each of the four indicator receptacles on the front panels of the amplifier and rectifier (I–201, I–204, I–301, and I–302).

(2) Open the upper door of the rectifier and install six rectifier Tubes JAN–575A (V–301 through V–306) in sockets (fig. 24). Reach up behind the meter panel and install two 25-watt, 120-volt tubular illuminating lamps (I–303 and I–304).

(3) Open the upper door of the amplifier and install two Tubes JAN–866A/866 (V–202 and V–203) as shown in figure 25. Install two 25-

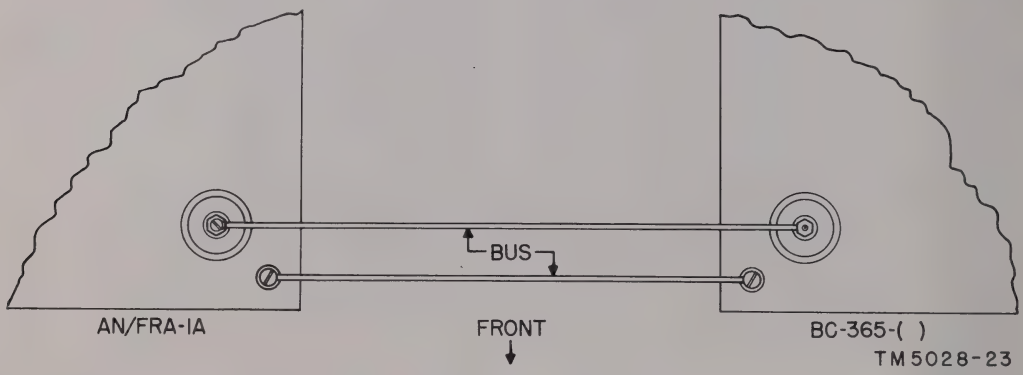


Figure 23. Grid excitation interconnections.

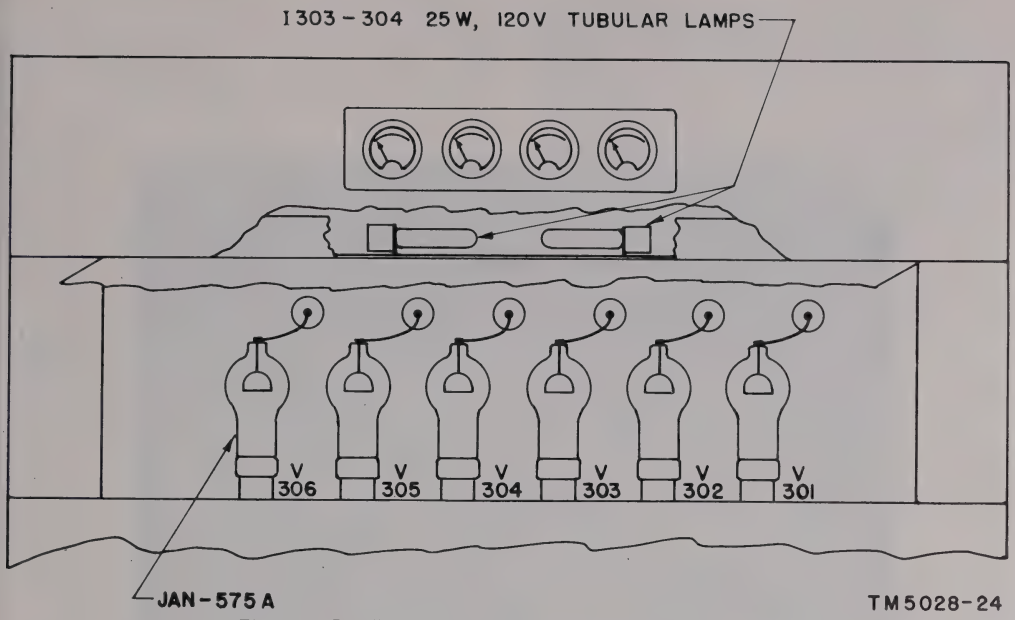


Figure 24. Installation of tubes and illuminating lamps in rectifier.

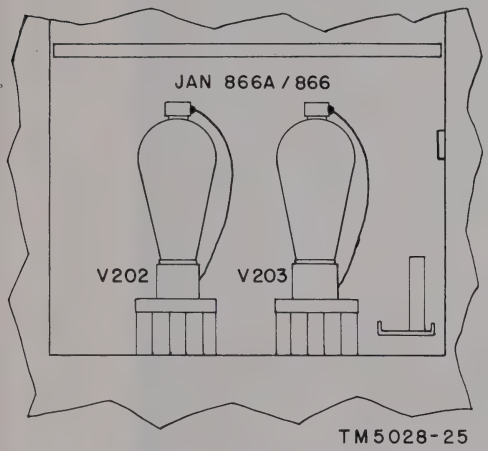


Figure 25. Installation of bias rectifier tubes in amplifier.

watt, 120-volt tubular lamps (I–202 and I–203) as in the rectifier.

(4) Install Tube JAN–891R (V–201) in large shell as shown in figure 26. Connect filament and grid leads as shown.

Caution: Handle Tube JAN–891R by the handles only. Avoid strain on pins when installing collet connectors. To loosen collet, turn the knurled sleeve clockwise; to tighten, turn the sleeve counterclockwise.

(5) Install a 1-watt neon lamp on the terminal board of harmonic coil L–403, in the hole marked I–205, as shown in figure 26.

(6) Note that the air interlock switch (S–208) paddle shown in figure 26 is swung down to avoid interference with the installation of amplifier Tube JAN–891R. After that tube has been installed,

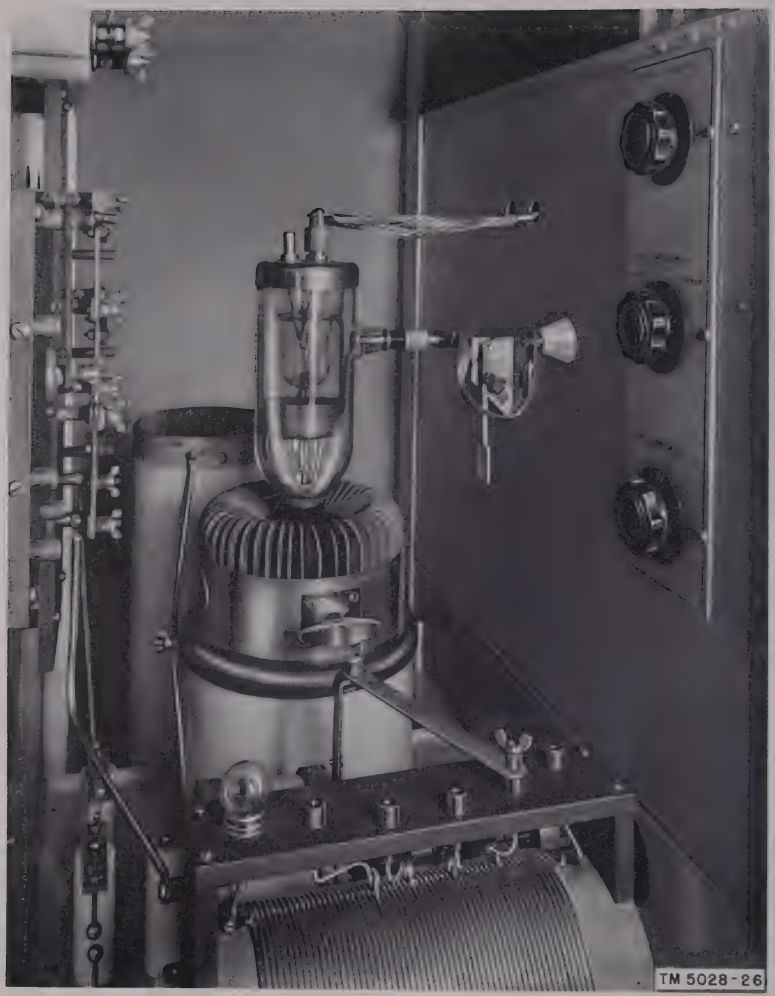


Figure 26. Installation of amplifier tube and neutralizing indicator lamp.

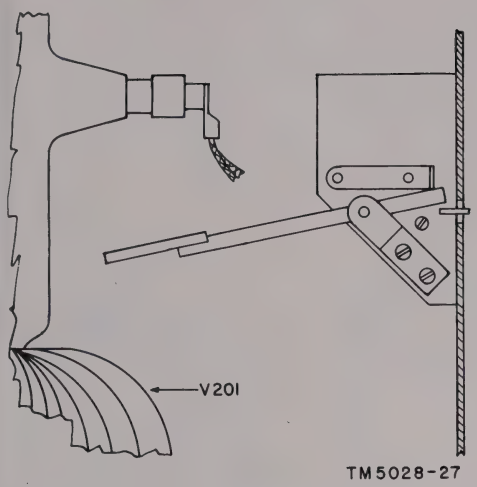


Figure 27. Normal position of air interlock switch paddle for no air stream.

swing up the paddle and snap the small stop bracket in place as shown in figure 27.

i. Adjustment of Spark Gaps. Locate spark gaps G–201 through G–205 on the amplifier. G–203 and G–204 are on the shelf which supports V–201 (Tube JAN–891R). G–201 and G–205 are on the shelf on the right side of the unit. G–202 is on the vertical partition to the right and behind V–201. Check spacing of spark gap balls as follows:

G–201: ⅛ inch.
G–202: ½ inch.
G–203: ½ inch
G–204: ¼ inch
G–205: ⅛ inch

j. Adjustment of Plate Overload Relay and Bias Interlock Relay Controls. Open the bottom doors on both the amplifier and rectifier, exposing the relay panels. Check settings of plate overload relay and bias interlock relay controls in accordance with the data on the nameplates of these controls.

k. Special Instructions for 50-Cycle Power.

Note. The coil of plate relay K–305 (behind lower door on rectifier, left side) is designed for *60-cycle operation only.* If the power source is 50-cycle, this coil *must* be replaced by a special 50-cycle coil, which can be found in the running spare parts kit.

20. Installation of Antenna Tuning Unit

Refer to figure 28 for identification of components of the antenna tuning unit house and the order of assembly.

Caution: Use only the hardware provided. This hardware is either brass or heavily copper-plated steel. Avoid using unplated ferrous hardware on the antenna tuning unit. Local overheating may result in fire if such hardware is used.

a. Preparation of Site. Clean an area 9 feet by 7 feet adjacent to the antenna down lead. The 9-foot dimension should be at right angles to the direction in which the transmission line will be run. Grade the plot level.

b. Foundation Posts (fig. 29). (1) Dig holes for foundation posts 2 feet below frost level.

(2) Bury posts, cut off square, and finish level in one plane approximately 12 inches above ground level.

(3) Drill holes for foundation hardware in the four corner posts.

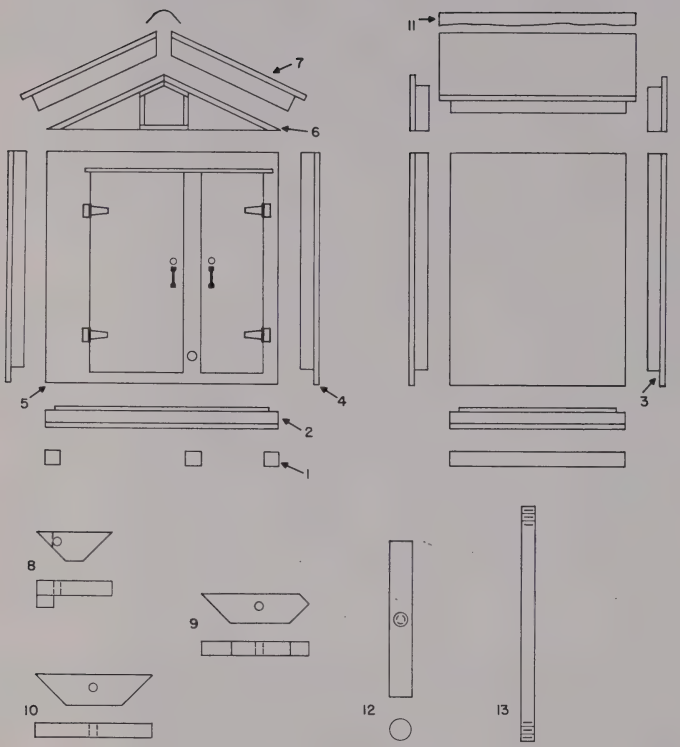
(4) Dress exposed wood with preservative.

c. Erecting House (fig. 30). (1) Lay a floor beam across each pair of foundation posts. Then lay the floor section on top of the floor beams. The aluminum side should be on top, and the edge marked FRONT should face the direction from which the transmission line will come. Dress the assembly so that the outer floor beams are flush with the edges of the floor and the middle floor beam is in the middle of the inside foundation posts. At the same time, check the alinement of the hole in each corner of the floor with the vertical hole in the corresponding foundation post.

(2) Erect the back section along the rear edge of the floor, keeping the end marked BOTTOM down against the floor. One man should hold up this section while the other sections are being assembled.

(3) Erect a side section (either one), along the right side of the floor, keeping the end marked BOTTOM against the floor. Drop a ⅜″–16 by 4½-inch carriage bolt into each of the two holes on the outside vertical edge of the back section, the head of the bolt on the outside, to hold the side which was just erected.

(4) Erect the other side section on the left side of the floor in similar fashion.



HOUSE PARTS

1. FLOOR BEAM - 3 REQ'D
2. FLOOR - 1 REQ'D
3. BACK - 1 REQ'D
4. SIDE - 2 REQ'D
5. FRONT - 1 REQ'D
6. GABLE - 2 REQ'D
7. ROOF - 2 REQ'D
8. GUSSET, RT. FRONT CORNER ONLY - 1 REQ'D
9. GUSSET, LEFT FRONT CORNER ONLY - 1 REQ'D
10. GUSSET, REAR ONLY - 2 REQ'D
11. CANVAS RIDGE COVER - 1 REQ'D
12. FOUNDATION CROSSPIN - 4 REQ'D
13. FOUNDATION STUD - 4 REQ'D

ASSEMBLY HARDWARE

3/4"-10 HEX NUT - 4 REQ'D
3/4" I.D. FLAT WASHER - 4 REQ'D
3/4" I.D. SPLIT RING LOCKWASHER - 4 REQ'D
3/8 X 4 1/2" CARRIAGE BOLT - 8 REQ'D
3/8 X 3" CARRIAGE BOLT - 2 REQ'D
3/8 X 3 1/2" CARRIAGE BOLT - 4 REQ'D
3/8 X 3 1/2" LAG SCREW - 2 REQ'D
3/8" I.D. FLAT WASHER - 16 REQ'D
3/8"-16 HEX NUT - 14 REQ'D
1 1/2 LONG COPPER NAIL - 20 REQ'D
OUTSIDE WHITE PAINT - 1 GALLON
PAINT BRUSH - 1 REQ'D

TM 5028-28

Figure 28. Antenna tuning unit house assembly.

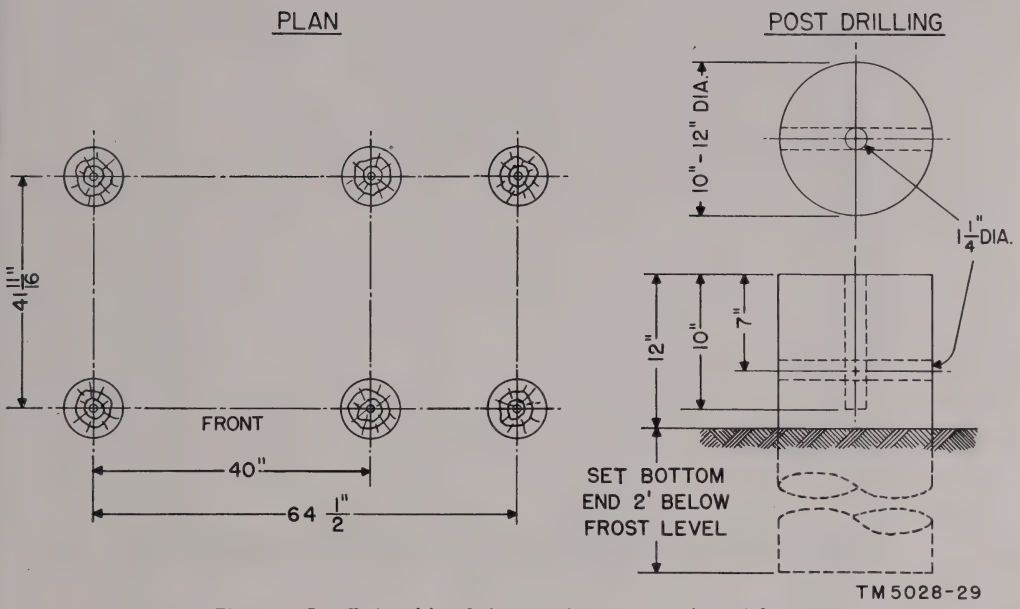


Figure 29. Installation of foundation posts for antenna tuning unit house.

(5) Erect the front section against the floor and sides, using four ⅜"–16 by 4½-inch long carriage bolts along the sides. The small door is to be on the right.

(6) Apply a ⅝-inch ID (inside diameter) flatwasher and ⅜"–16 hexagonal nut to each of the carriage bolts installed so far, and tighten all of them.

(7) Drop a ⅜-inch by 3½-inch long lag screw and flatwasher into the hole in the middle of the inside bottom horizontal member of the front and back sections, and screw it into the floor.

(8) Erect a gable section on top of the back section, using two ⅜"–16 by 3½-inch long carriage bolts, with flatwashers and nuts, but leave the nuts fingertight.

(9) Erect the other gable section on top of the front section in similar fashion.

(10) Slide a roof section up on one side until it latches into place in the prefabricated grooves.

(11) Erect the other roof section similarly.

(12) Pass a ⅜"–16 by 3-inch long carriage bolt through each of the two holes in the topmost stringers of the roof section, and fasten with flatwasher and nut.

(13) Tighten nuts on bolts in gable and roof sections.

(14) Fasten the canvas ridge cover over the crack between the two roof sections, using the copper nails provided.

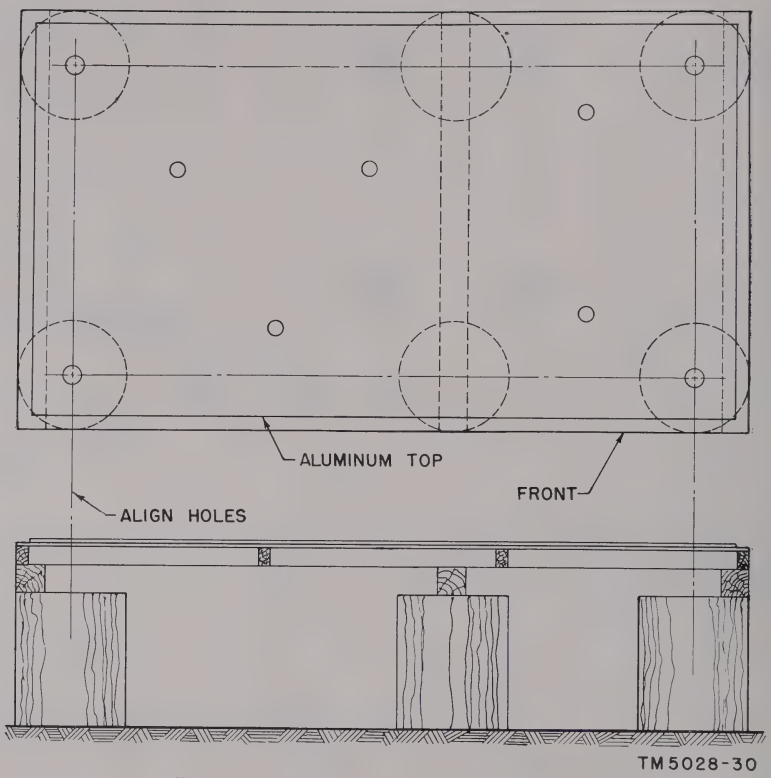


Figure 30. Laying floor of antenna tuning unit house.

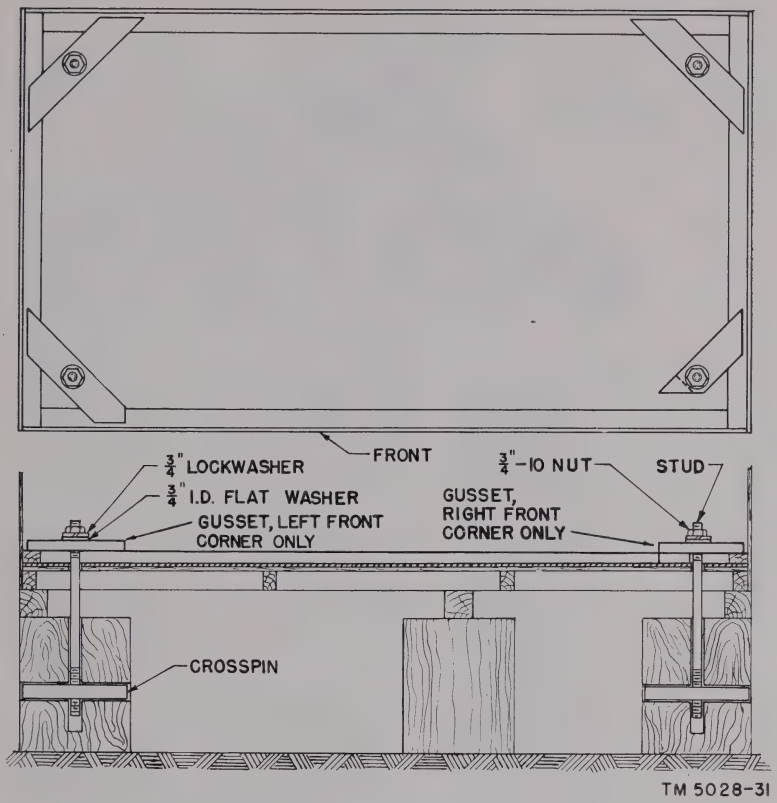


Figure 31. Bolting antenna tuning unit house to foundation posts.

(15) Referring to figure 31, install corner gussets in each bottom inside corner of the house. Note that a special gusset is used in the right front corner. Use the cross-pins, foundation studs, and ¾-inch hardware (these items are all copper-plated steel) to compress the gussets down against the wall stringers. Tighten the nuts securely.

(16) Using 1½-inch long copper nails, nail the sides of the roof sections to the front and back wall sections.

(17) There is an apex cut-out in each gable, the outside edges of which are overlapped with wooden strips held down by wood screws. Remove these strips, preserving the wood screws. In the back gable, toward the antenna, install the antenna insulator board subassembly (fig. 7), securing it by replacing the wooden strips. Install the transmission line insulator board subassembly (fig. 8) similarly on the front gable.

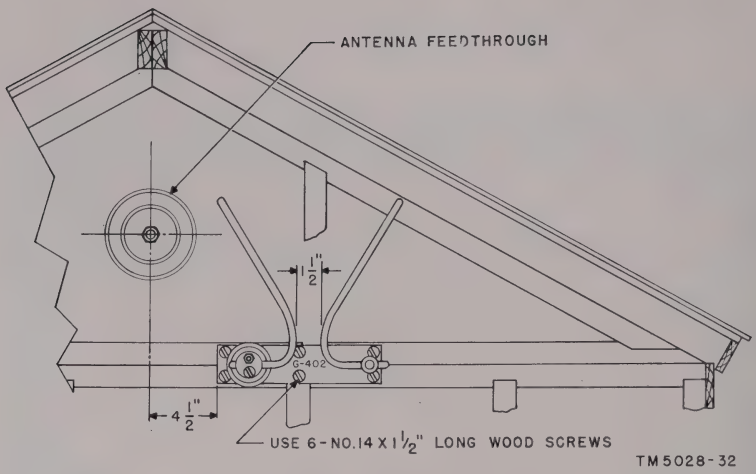


Figure 32. Installation of horn gap subassembly in antenna tuning unit house.

(18) Referring to figure 32, install the horn gap subassembly G–402 on the inside back wall of the house, adjacent to the antenna feed-through. Use six wood screws supplied with the horn gap, pre-drilling holes for them with a No. 35 drill. Spot the holes through the chassis of the gap. After mounting, adjust the horn gap electrodes so that they are symmetrical, vertical, and 1½ inches apart at the closest point.

(19) The main subassembly for the antenna tuning unit (containing tuning and loading controls, meters, etc.) has been identified in figure 5. Lift this subassembly and slide it through the opening behind the right front door (fig. 33). Observe that there is one hole in each of the two transverse bottom frame angles. Maneuver the subassembly until these holes coincide with corresponding holes through the floor of the house. Bolt into place, using the bag of hardware tied to the TUNING control wheel.

(20) The antenna loading coil (L–402) has been identified in figure 9. Lift this coil up and slide it through the opening behind the left front door (fig. 33). Maneuver the coil, with the terminals facing front, until the holes in the three mounting brackets at the bottom of the coil coincide with corresponding holes in the floor of the house. Bolt into place, using the bag of hardware tied to terminal L of the coil.

Caution: Do not handle the coil by the winding. Grasp the coil through the finger holes on the unwound bottom section, using an extra man to steady the top of the coil.

(21) Install a 1-watt neon lamp in the receptacle in the upper left-hand corner of the control panel.

(22) Check spacing of spark gap G–401 in the upper right-hand corner of the back of the control panel. Spacing should be one-fourth inch.

d. Connections in Antenna Tuning Unit. (1) Connect the bus tagged L402 TERM. A–ANT. from terminal A of antenna loading coil L–402 to the antenna feed-through stud (fig. 34). Connect this bus under the link running from L–402 terminal A to terminal B. Then connect the bus tagged G402–ANT. from the insulated electrode of the horn gap subassembly (G–402) to the antenna feed-through stud. A stud on the outer end of the electrode mounting is provided for this purpose and is marked CONNECT TO ANT. Readjust electrode if required.

(2) Connect a piece of No. 6 copperweld wire from the grounded electrode of the horn gap subassembly to the ground terminal on the rear left side of the main subassembly frame (fig. 34). This ground terminal is marked GROUND FOR G402. A hole and setscrew tagged GROUND are provided at the base end of the grounded electrode of the horn gap assembly for making connection. Tin the ends of the copperweld wire before making the connections to avoid electrolytic action. Dress the wire along the back wall joist under the horn gap, tacking it down with the

Figure 33. Antenna tuning unit, interior view.

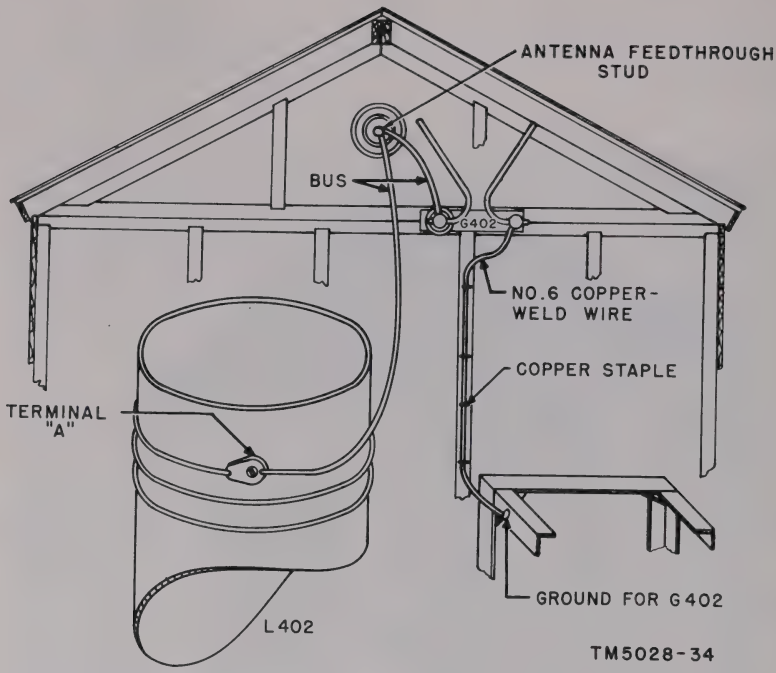


Figure 34. Connections to antenna feed-through stud, antenna loading coil, and horn gap.

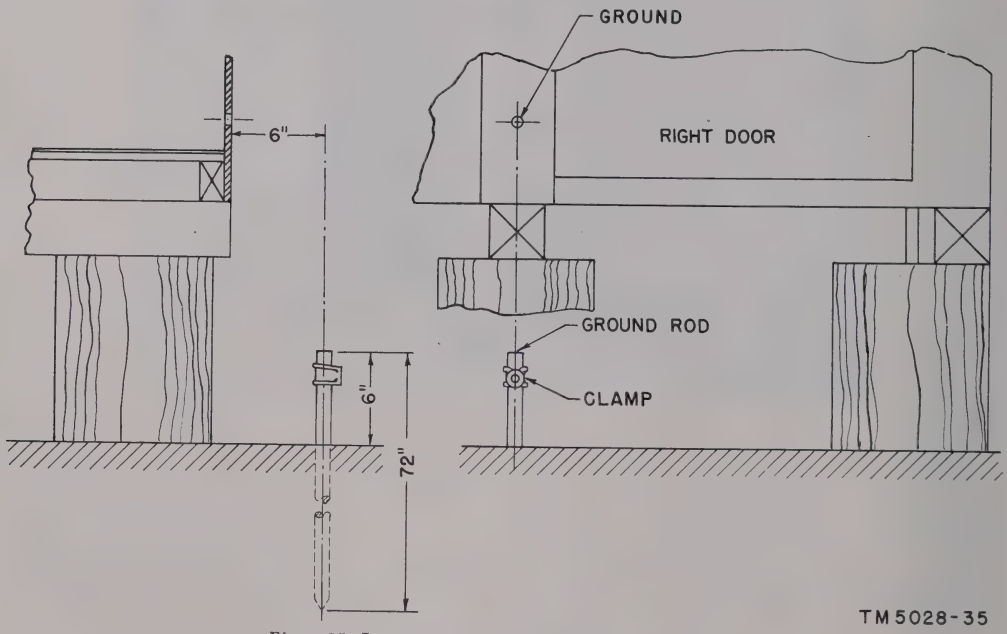


Figure 35. Location of ground rod for antenna tuning unit.

copper staples. The staples and wire are provided in the transmission line kit.

(3) Install a ground rod and clamp (from transmission line kit, identified in figure 4) as shown in figure 35. Locate the ground rod in the same line with the hole marked GROUND in the front of the house, between the doors.

(4) Referring to figure 36, complete connections in the antenna tuning unit as follows:

(5) Connect the bus tagged GROUND from the terminal marked A. T. U. GROUND on the main subassembly to the ground rod just installed, running it through the hole in the front of the house. This bus is flattened and punched on one

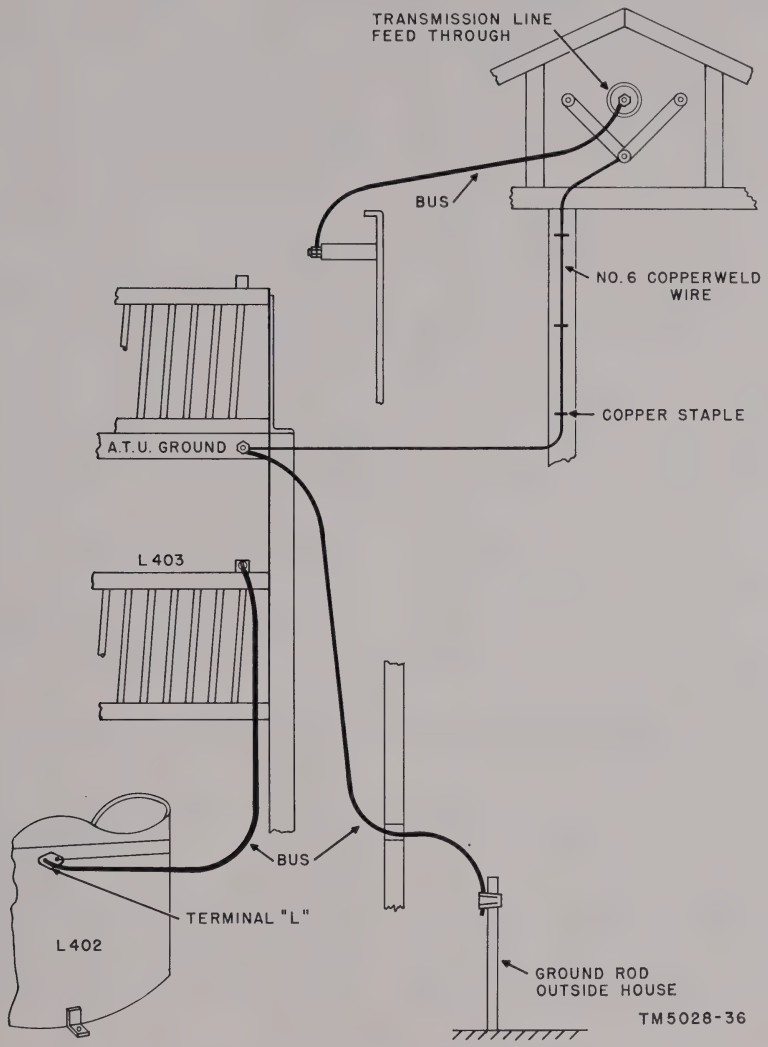


Figure 36. Connections in antenna tuning unit.

end for connecting to the A. T. U. GROUND terminal. Cut, flatten, and trim the other end to fit the ground rod clamp.

(6) Connect the bus tagged L402–L403 from terminal L of antenna loading coil L–402 to the terminal on tuning coil L–403 tagged CONNECT TO L402. In making the connection to terminal L of L–402, place the bus under the link strap already in place on that terminal.

(7) Connect the bus marked TRANS. LINE between the transmission line feed-through stud and the topmost insulator on the back of the control panel. The latter terminal is tagged CONNECT TO TRANSMISSION LINE. Keep this bus at least 2 inches away from wood or metal.

(8) Using a piece of No. 6 copperweld wire, connect between the A. T. U. GROUND terminal on the main subassembly to the junction of the straps which connect the ground wire studs on the transmission line insulator board assembly. This junction is tagged GROUND. Dress the wire along the joist nearest the control panel, holding it down with a few copper staples. Tin the ends of the wire to avoid electrolytic action.

e. Installation of Transmission Line. (1) The general lay-out for the transmission line has been given in figure 14. The transmission line may be any length up to 300 feet. It is recommended that a pole be installed 12½ feet from the transmitter house and another pole 12½ feet from the antenna tuning unit house, with poles between them not more than 25 feet apart. Erect poles upright at a uniform height above the terrain, allowing the transmission line to follow the terrain. Detailed procedure follows.

(2) Cut poles to the length determined by the formula 10 feet plus depth of frost level. Treat exposed wood with preservative.

(3) Attach a transmission line support assembly to the top end of each pole as shown in figure 37. Use two ⅜- by 1½-inch long copper-plated steel lag bolts (supplied with the kit). Pre-drill lag bolt holes with a No. 8 drill.

(4) Spot hole sites and dig holes to uniform depth 2 feet below frost level.

(5) Erect poles, dressing them so that the transmission line support assemblies are parallel to each other and at right angles to the transmission line.

(6) Bury a ground rod close to each pole, in a line underneath the grounding screw on the support assembly.

(7) Connect a piece of No. 6 copperweld wire from the support assembly to the ground rod clamp at each pole. Dress the wire along the pole and fasten about every foot with a copper staple.

(8) Referring to figure 38, run the outside (ground) wires of the transmission line from the amplifier to the antenna tuning unit. Use a separate 360-foot roll of No. 10 copperweld wire for each side. Proceed as follows: Remove enough wire from each roll to reach from outside the transmitter house to the transmission line ground studs on top of the amplifier. Pass these wires through the house and connect them to the ground studs on the amplifier. Then, using a stepladder, pass the wires through the clamps on either end of the transmission line support assemblies (remove the nut on the clamp, slip in the wire, and replace the nut, leaving the nut loose to allow play in the wire). Proceed in this way until reaching the antenna tuning unit. Then pass the wires through the special studs on the transmission line insulator board. Tighten both wires and clamp them in the studs while they are taut (fig. 39).

(9) Using the third 360-foot roll of No. 10 copperweld wire, connect a piece of the wire between the output insulator stud on the amplifier and the feed-through on the transmitter house. Use spreader insulators inside the transmitter house as required, attaching them as shown in the detail of figure 38.

(10) Lay in the center wire between the outside stud of the transmitter house feed-through to the feed-through on the antenna tuning unit. Begin at one end, attaching the wire by means of a spreader insulator 18 inches from the feed-through. Leave slack wire for connecting to the feed-through, but do not make the connection yet. Continue laying in the center wire and attaching by means of spreader insulators until the other end is reached, leaving slack for making the connections. Then make the connections to the

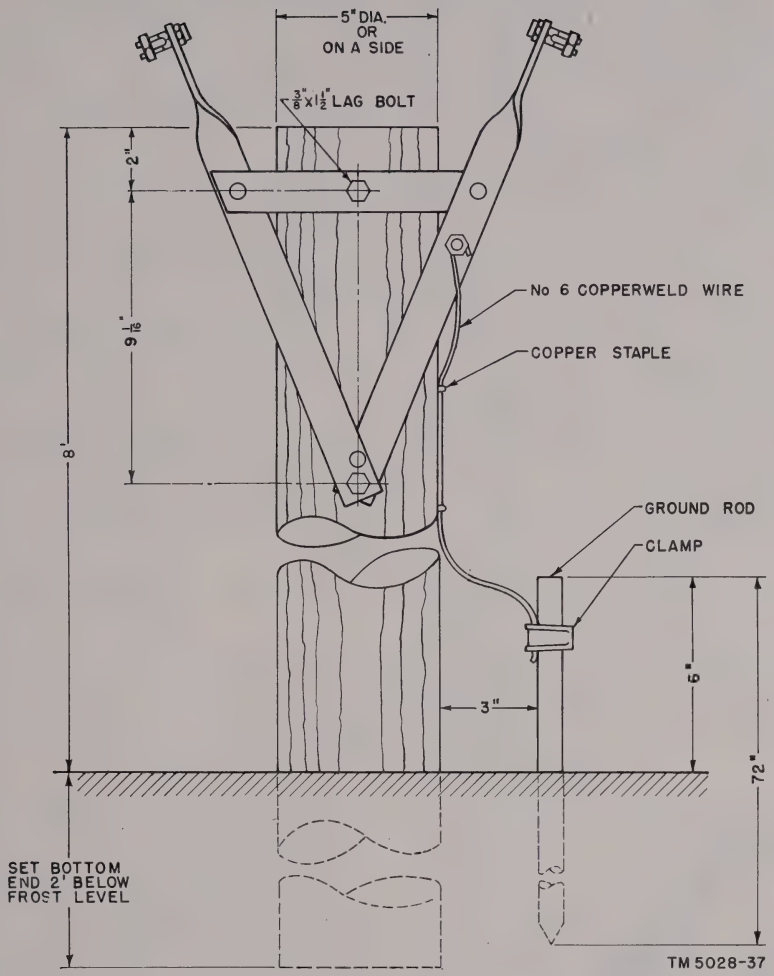


Figure 37. Assembly of transmission line pole.

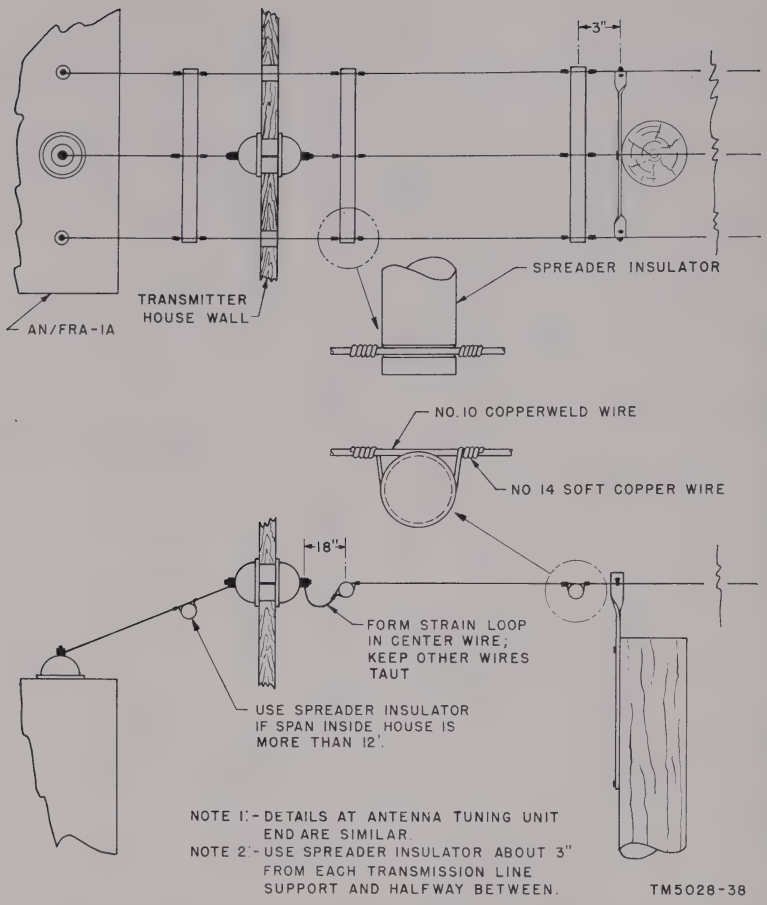

3"
SPREADER INSULATOR
TRANSMITTER HOUSE WALL
AN/FRA-1A
NO. 10 COPPERWELD WIRE
NO 14 SOFT COPPER WIRE
18"
FORM STRAIN LOOP IN CENTER WIRE; KEEP OTHER WIRES TAUT
USE SPREADER INSULATOR IF SPAN INSIDE HOUSE IS MORE THAN 12'.
NOTE 1:- DETAILS AT ANTENNA TUNING UNIT END ARE SIMILAR.
NOTE 2:- USE SPREADER INSULATOR ABOUT 3" FROM EACH TRANSMISSION LINE SUPPORT AND HALFWAY BETWEEN.
TM5028-38

Figure 38. Transmission line installation details.

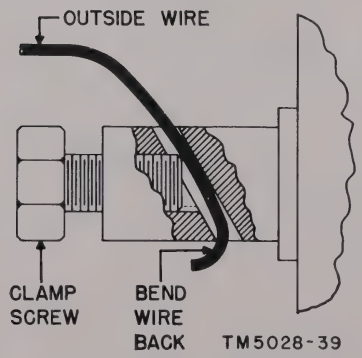


Figure 39. Detail of connection of outside wire of transmission line at antenna tuning unit.

feed-throughs at both ends, allowing slack for a strain loop.

(11) Tighten the clamp nuts on all of the transmission line supports. This completes the installation of the transmission line.

f. Antenna Connection. Connect the down lead of the antenna to the antenna feed-through stud on the back of the antenna tuning unit. Allow slack for a strain loop.

g. Painting Antenna Tuning Unit House. After all work has been done around the antenna tuning unit, paint the outside of the house with the paint and brush provided. Avoid painting the door locks and feed-through insulators. This completes installation of the entire equipment.

21. Knowledge of Theory of Operation Required

Before attempting to tune this equipment, all personnel concerned should acquaint themselves thoroughly with the theory of operation given in part five, including references to TM 11–828. Certain limitations are imposed by the fact that it is necessary to connect Amplifier Assembly AN/FRA–1A to Radio Transmitter BC–365–( ) without making circuit changes in the exciter. The normal exciter control circuits are used to control the entire equipment; thus the tuning and control sequences of this equipment are somewhat unconventional. If the antenna characteristics are not known, an important part of the tuning procedure will be long, drawn out, and experimental in nature. This equipment is high-powered and operates with high voltages and currents with consequent danger to personnel and equipment. At least two and preferably three men are required for tuning, and it is essential that their work be coordinated on the basis of complete understanding of the equipment. For these reasons, all personnel concerned must study this manual prior to actual operation of the equipment.

22. Controls and Instruments on Amplifier and Rectifier (figs. 40 and 41).

a. Functions.

Item	Function
MAIN LINE switch (S–301).	Circuit breaker; controls power to amplifier and rectifier, but not to exciter.
FILAMENT switch (on rectifier, S–302).	Circuit breaker; controls power to filaments of plate rectifier tubes and rectifier blower.
FILAMENT switch (on amplifier, S–207).	Circuit breaker; controls power to amplifier tube only.
BIAS switch (S–202)	Circuit breaker; controls power to bias rectifier subassembly (filament and plate).
FILAMENT CONTROL (on rectifier, T–308).	Variac; sets voltage to filament of plate rectifier tubes.
FILAMENT CONTROL (on amplifier, T–204).	Variac; sets voltage to filament of amplifier tube.
BIAS RECTIFIER PRIMARY SWITCH (S–219).	Selects taps on bias plate and filament transformers to match line voltage.
PRI. VOLTAGE ADJ. switch (S–303).	Selects taps on plate rectifier transformers to match line voltage.
PLATE VOLTAGE switch (S–305).	Gives full plate voltage in HIGH position, about half plate voltage in LOW position.
LINE VOLTAGE switch (S–310).	Switches LINE VOLTAGE meter to measure voltage on each phase of three-phase power line.
R. F. LINE AMMETER switch (S–201).	Inserts R. F. LINE CURRENT meter in READ position; removes it in SHORT position.
PLATE TUNING wheel (L–206).	Resonates plate circuit.
GRID TUNING wheel (L–201).	Resonates grid circuit.
EMERGENCY TUNING switch (S–221).	Rough tuning of emergency matching coil between exciter and transmission line.
GRID FUNCTION SWITCH (S–205).	In OPERATE position, connects exciter to grid circuit of amplifier tube; in TUNE position, connects dummy load to output of exciter; in EMERGENCY position, connects output of exciter to transmission line through emergency matching coil.
GRID TUNING SWITCH (S–210).	Selects grid tank coil taps and capacitors.
HARMONIC COIL TAPS (L–203).	Rough tuning of harmonic coil to suppress second harmonic of carrier frequency.
PLATE COIL TAPS (L–206).	Select plate tank coil taps.
PLATE CAPACITOR LINKS (C–208 through C–213, C–216 through C–219, C–232, and C–233).	Select plate tank capacitors.
NEUTRALIZING LINK.	Opens transmission line to permit sensitive neutralizing adjustment.
NEUTRALIZING INDICATOR (I–205).	Neon lamp neutralizing indicator.
LINE VOLTAGE meter (M–304).	Reads power line voltage.
FILAMENT HOURS meter (M–302).	Reads total running time of filaments.
FIL. PRIMARY meter (M–303).	Reads voltage on primary of plate rectifier tube filament transformers.
PLATE VOLTAGE meter (M–301).	Reads plate voltage on amplifier tube.

Item	Function
FIL. VOLTAGE meter (M–204).	Reads filament voltage on amplifier tube.
GRID CURRENT meter (M–201).	Reads grid current of amplifier tube.
PLATE CURRENT meter (M–202).	Reads plate current of amplifier tube.
R. F. LINE CURRENT meter (M–203).	Reads transmission line current.

b. Special Features. (1) The PRI. VOLTAGE ADJ. switch is a rotary switch having positions 90° apart. Three positions are marked 200, 220, and 240, respectively. The fourth position is reached when the pointer is straight down. This position is actually an "off" position; it disconnects the primaries of the plate transformers and is useful in tuning.

(2) The PRI. VOLTAGE ADJ. and PLATE VOLTAGE switches have similar mechanisms, featuring a heavy toggle action. To operate these switches, turn the pointer well past the desired position until the toggle is heard to operate; then release the wheel. The pointer will swing back and come to rest at the desired position. The PRI. VOLTAGE ADJ. switch can be rotated in either direction to reach a given point; the PLATE VOLTAGE switch turns only 90° between its two positions.

(3) The small knobs underneath the GRID TUNING and PLATE TUNING wheels are locking knobs. To lock, turn clockwise until tight.

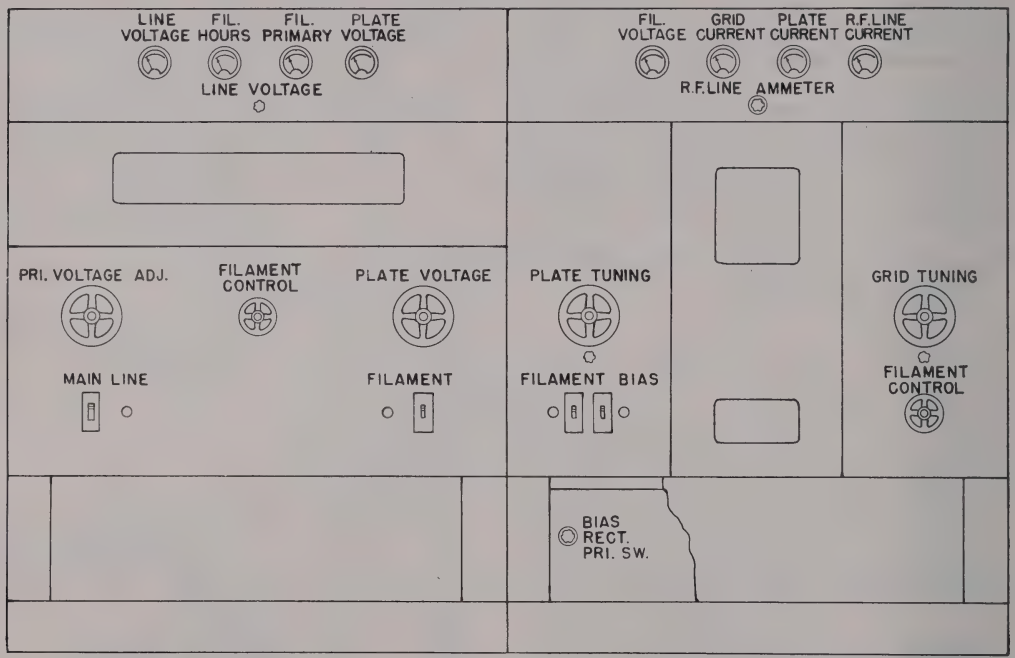


Figure 40. Controls and instruments on amplifier and rectifier.

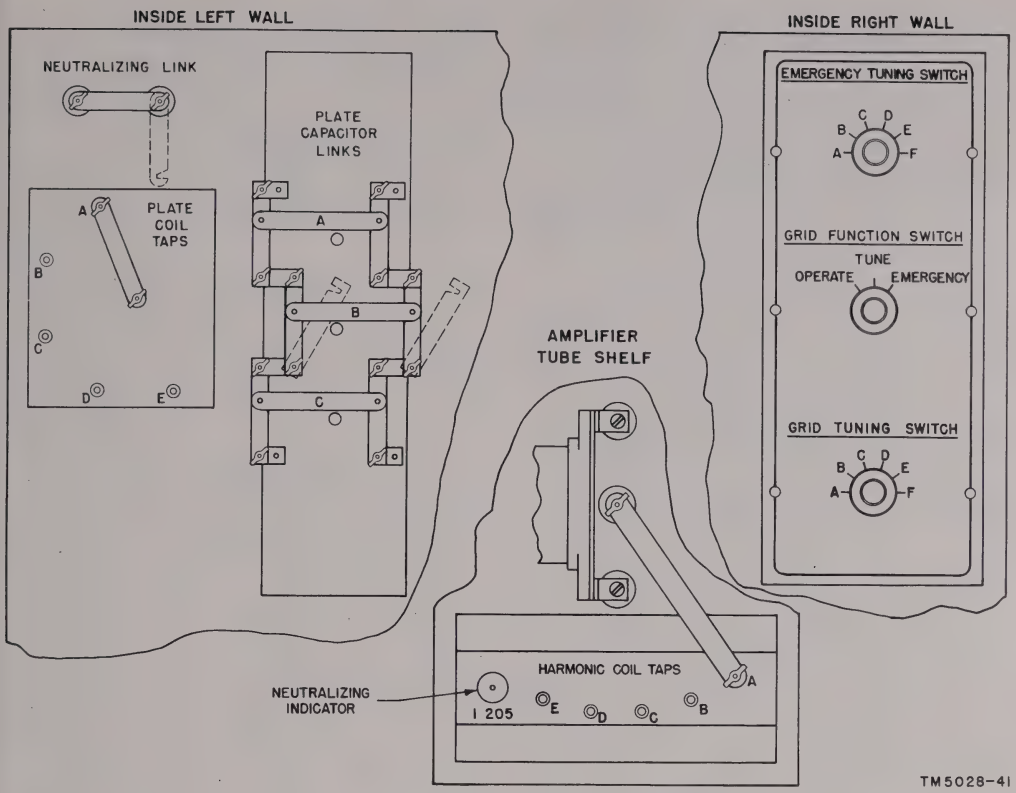


Figure 41. Switches and links used in tuning amplifier.

23. Controls and Instruments on Antenna Tuning Unit (fig. 42)

a. Functions.

Item	Function
R. F. LINE CURRENT meter (M–402).	Reads transmission line current.
R. F. LINE AMMETER switch (S–402).	Inserts R. F. LINE CURRENT meter in READ position: removes it in SHORT position.
ANT. COUPLING wheel (L–401).	Controls inductance of coupling coil L–401.
ANTENNA CURRENT meter (M–401).	Reads antenna current.
ANT. CURRENT AMMETER switch (S–401).	Inserts ANTENNA CURRENT meter in READ position: removes it in SHORT position.
ANT. TUNING wheel (L–403).	Controls inductance of tuning coil L–403.
ANTENNA LOADING COIL LINKS (L–402).	Coarse adjustment of antenna loading coil inductance.

b. Special Features: (1) The small knobs underneath the ANT. TUNING and ANT. COUPLING wheels are locking knobs. To lock, turn clockwise until tight.

(2) The ANT. CURRENT AMMETER switch does not have positive detents. Turn until stops are hit.

(3) The antenna loading coil (L–402) has a total of 70 turns. By means of the shorting links provided, the number of turns in use can be varied in two- or three-turn jumps. The coarse jumps in inductance are overlapped by the variable tuning coil L–403.

(4) The ANT. COUPLING and ANT. TUNING dials are the counter-type. The scales are divided into 100 parts in 180°. The coils (L–401 and L–403) each have 24 turns, and one turn of the handwheel moves the scale 4 divisions. Notice that the action of these controls is a little soft because of the tandem flexible couplings. This is

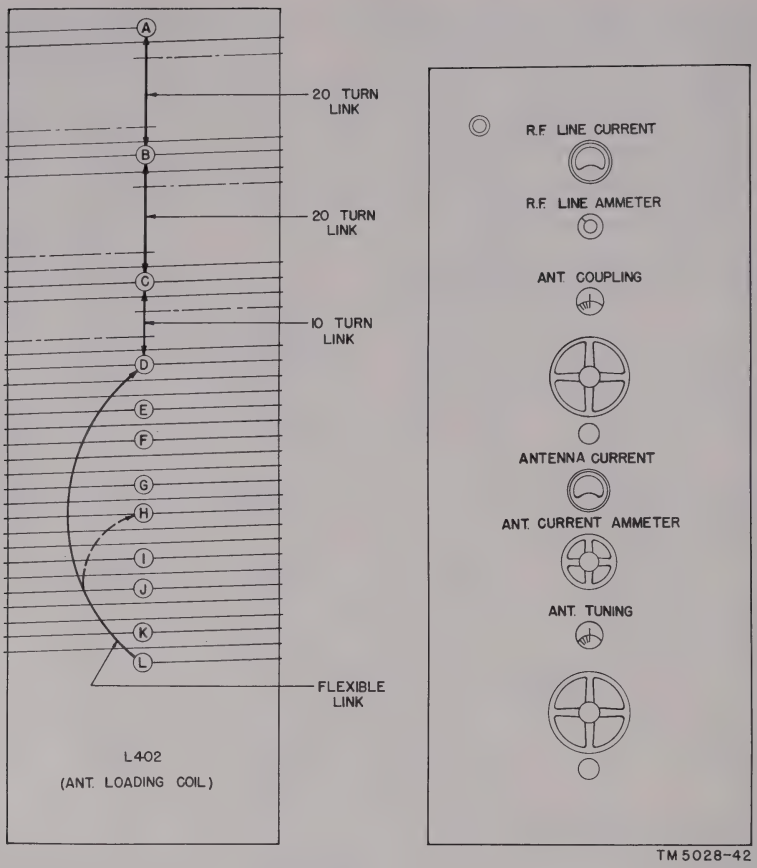


Figure 42. Controls and instruments on antenna tuning unit.

normal and permissible, so long as all the set-screws and other coupling hardware are tight.

24. Controls and Instruments on Exciter

Refer to TM 11–828.

25. Preliminary Adjustments

Note. All panels should be on and all doors closed except as directed.

a. Line Voltage Check. (1) Start with all power switches in OFF position. The position of other switches and controls is unimportant.

(2) Throw MAIN LINE switch on rectifier to ON (meter illuminating lamps on rectifier only should light up).

(3) Using LINE VOLTAGE switch on rectifier, read and record voltages on all phases of the power line.

(4) The voltages read should be between 195 and 240 volts, and the voltages on each phase should be within 5 volts of each other. If this condition is not obtained, cease operations until the power source is checked.

(5) Note line voltage reading on phase 1–2. Set BIAS RECTIFIER PRIMARY SWITCH as follows:

Voltage reading on phase 1–2	Set BIAS RECTIFIER PRIMARY SWITCH to—
195 to 210	200
210 to 230	220
230 to 245	240

(6) Note the average of the phase readings. Use this value in setting the PRI. VOLTAGE ADJ. switch in subsequent operations, using the table of limits in (5) above.

b. Blower Check. The purpose of this check is to see whether the blower motors turn in the right direction. Proceed as follows:

(1) Turn FILAMENT CONTROL knobs on both rectifier and amplifier to extreme counterclockwise position.

(2) Set PRI. VOLTAGE ADJ. switch to OFF position (pointer straight down).

(3) Set all power switches to ON position except FILAMENT switch of amplifier and FILAMENT and PLATE switches of exciter. *The PLATE switch of the exciter is NOT to be used at any point in this check.*

(4) Open upper door on rectifier.

(5) Close FILAMENT switch of exciter. Green indicator on exciter should light up immediately. After about 11 seconds, the green indicator on the rectifier should light up and the rectifier blower should start. Feel for air stream at holes behind rectifier tubes through upper door on rectifier. If no air stream is felt and blower motor sounds overloaded, the power line connections to the three-phase blower motors are wrong. Throw FILAMENT switch on exciter to OFF position immediately.

(6) If blower turns in wrong direction as found in (5) above, correct as follows:

(*a*) Remove power from three-phase power line by means of transmitter house disconnect switch.

(*b*) Remove left side bottom panel on rectifier and interchange the power leads on terminals 1 and 2 on the input terminal board. Replace panel.

c. Initial Control Circuit Check. The purpose of this check is to see whether the interconnections to the exciter are correct. Proceed as follows:

(1) Open right side door on exciter and remove plate leads to rectifier tubes V–8 through V–11. Dress leads so that they are well clear of chassis and plate caps. This will permit operation of the complete control circuit of exciter without applying plate voltage.

(2) Close all doors.

(3) Set PRI. VOLTAGE ADJ. switch to OFF position (straight down).

(4) Set all power switches to ON position except FILAMENT switch on amplifier and FILAMENT switch on exciter.

(5) Close FILAMENT switch on amplifier. The amplifier blower should start. Leave switch closed.

(6) Close FILAMENT switch on exciter. The following sequence of events should occur:

(*a*) After 11 seconds, the rectifier blower will start and the green indicators on the rectifier and amplifier will light, indicating presence of filament primary voltage in both units.

(*b*) After another 45 seconds, the plate relay of the rectifier will be heard to operate and the red indicator on the rectifier will light, indicating presence of plate primary voltage (there is no plate voltage yet because PRI. VOLTAGE ADJ. switch is in OFF position).

(*c*) Shortly before or after the preceding event, the red indicator on the exciter will light up, indicating presence of plate primary voltage on that unit. Rectifier and exciter plate voltage do not go on simultaneously because the units have different time delay relays.

(7) If step (6) (*a*) above is obtained, but neither step (6) (*b*) nor step (6) (*c*) is obtained after a reasonable period of time, the fault probably lies in the interconnection to relay RL–3 on the exciter. Some models of Radio Transmitter BC–365–( ) may have the leads to the coil of RL–3 reversed. To correct, proceed as follows:

(*a*) Throw FILAMENT switch on exciter to OFF position. Observe that all indicators go out and that the rectifier blower stops running. The amplifier blower, however, will keep running for 5 minutes and then shut itself off automatically. This overrunning period cools off the amplifier tube after all voltages are removed.

(*b*) After the amplifier blower has overrun for 5 minutes and shut itself off, disconnect all power from the equipment by means of the transmitter house disconnect switch. Open the right-hand door of the exciter and interchange the leads on RL–3. That is, remove interconnection wire No. 6 from the left coil terminal of RL–3 and replace the one or two wires removed thereform. Disconnect the one or two wires from the right coil terminal of RL–3, connect wire No. 6 thereto, and tape up the wire or wries removed (if two, connect together before taping). Reconnect power and close the door.

26. Practice with Control Circuit

After the preliminary adjustments of paragraph 25 have been made, practice with the control circuits

before proceeding with tuning and actual operation. The purpose of this paragraph is to point out the peculiarities of the control system and the proper way of operating the equipment.

a. Normal Control (Local or Remote). (1) Note that *none* of the power switches on the rectifier or amplifier is used for normal control. These switches are circuit breakers, used essentially for circuit protection and isolation in the event of faults requiring trouble shooting.

(2) In normal control, *all* power switches on the rectifier and amplifier are left in the ON position. Starting and stopping of the equipment is controlled *only* by means of the exciter controls (local or remote).

(3) No other type of control is permissible except for special trouble-shooting procedures.

b. Local Control. In general, local control is used only for tuning or trouble shooting.

(1) Close all power switches on all three units and the TEST KEY on the exciter, but do not close the PLATE switch on exciter.

(2) Start equipment by throwing exciter FILAMENT switch to ON position. Equipment will be ready for operation in approximately a minute, when time delay relays have closed.

(3) Actual transmission is obtained when excitation to the amplifier is supplied by the exciter. The PLATE switch on the exciter is used for this purpose. *Do not operate* the PLATE switch during the practice period.

(4) Stop equipment by throwing exciter FILAMENT switch to OFF position. Amplifier blower will overrun 5 minutes.

(5) The equipment may be started again whether or not the amplifier blower is overrunning or has quit. In either case the blower will overrun 5 minutes the next time the equipment is stopped.

Note. If operations are started with all switches open, the amplifier blower will start as soon as the MAIN LINE switch on the rectifier and the FILAMENT switch on the amplifier are closed (the amplifier BIAS and rectifier FILAMENT switch may be open or closed). The blower will continue to run and then will shut off automatically after 5 minutes. After that, both the amplifier and rectifier blowers will start 11 seconds after the rectifier and exciter FILAMENT switches are closed (BIAS switch may be open or closed).

c. Remote Control (for Radio Operators). In actual use, the equipment will probably be controlled from the operating room using Remote Control Unit RM–10–( ).

(1) Set all power switches on all three main units to ON position except the FILAMENT and PLATE switches on the exciter.

(2) Start equipment by throwing TRANSMITTER switch on remote control unit to ON position. Equipment will be ready for transmission in approximately a minute.

(3) Transmit, using hand key or machine keyer plugged into KEY jack of remote control unit.

(4) To stop equipment, throw TRANSMITTER switch on remote control unit to Off position.

(5) For stand-by operation, leave TRANSMITTER switch in ON position. Transmit at will, using hand or machine keyer.

d. Operation After Overload. If plate voltage in the amplifier is removed by the operation of any protective device, it cannot be restored until the FILAMENT switch on the exciter (local control condition) or the TRANSMITTER switch on the remote control unit is first thrown to OFF position. After the fault has been cleared, plate voltage can be restored by throwing the switch to ON position again at least 3 seconds after opening. The normal control sequence will then occur, including the time delay. A typical example, which may occur during the tuning procedure, would be if mistuning in the amplifier causes the rectifier plate overload relay to trip due to excessive plate current. Operation cannot be resumed until the FILAMENT switch on the exciter is thrown OFF and then ON again after at least 3 seconds delay.

e. Door Interlock Operation. *Observe that opening any door on the amplifier or rectifier removes plate voltage on the exciter as well. However, opening a door on the exciter removes plate voltage from the exciter only.*

f. High-Voltage Grounding Switches. Each door on the amplifier and rectifier actuates a high-voltage grounding switch in addition to primary interlocks. These switches will discharge high-voltage capacitors which accidentally remain charged, or will cause the MAIN LINE breaker to trip if the plate relay is frozen.

Warning: Do not depend on door interlocks and high-voltage grounding switches. Before entering equipment, touch exposed high-voltage points with GROUND HOOK clipped to chassis. This includes tuning links, capacitors, and plates of tubes (fig. 43).

g. Special Circumstances Affecting Blowers. Under some circumstances beyond the control of operating personnel, the overrunning period of the amplifier blower may be cut short.

No damage will be done to the amplifier tube provided this does not happen frequently. These and other special circumstances are discussed below.

(1) If for any reason a fault develops which causes the MAIN LINE switch (circuit breaker) on the rectifier or the FILAMENT switch (circuit breaker) on the amplifier to open, the overrunning period of the amplifier blower may be cut short or may never begin at all. The same thing will happen if for any reason at least two of the power line fuses (if used) in the transmitter house blow out.

(2) If for any reason *only one* power line fuse in the transmitter house opens, either during normal operation or during the overrunning period of the amplifier blower, the rectifier and/or amplifier blowers may continue running on two phases instead of three. *This is a dangerous condition of operation for the blowers and must be stopped immediately by throwing the MAIN LINE switch on the rectifier to OFF position,* even though the amplifier blower may be in its overrunning period. If the blowers are running on two phases, they will emit a heavy groaning sound easily distinguishable from their normal running sound.

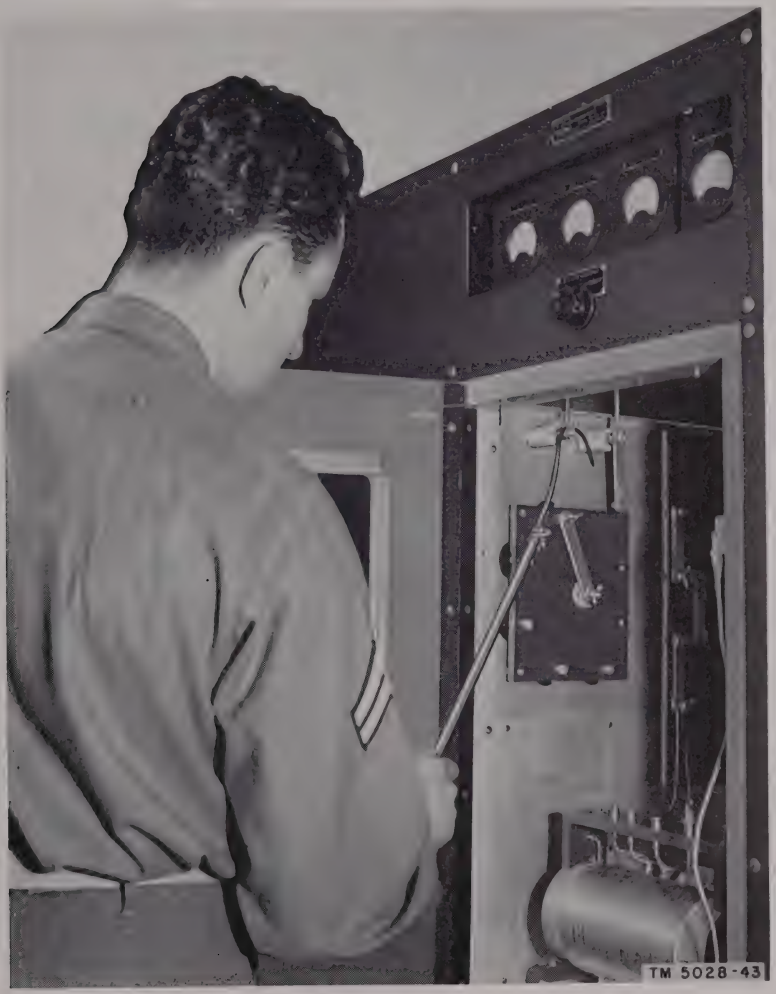


Figure 43. Using ground hook on neutralizing link.

(3) The overrunning period of the amplifier blower should never be willfully interrupted except as discussed above. Note that throwing off either MAIN LINE switch on the rectifier or the FILAMENT switch on the amplifier will interrupt the overrunning period. Operation of other switches will not affect it.

h. Final Adjustments Prior to Tuning. After through practice with the control functions, proceed as follows:

(1) Begin with equipment set up as it has been up to now. To summarize the conditions: MAIN LINE, FILAMENT, and BIAS switches on rectifier and amplifier closed; TEST KEY on exciter closed; FILAMENT and PLATE switches on exciter open; PRI. VOLTAGE ADJ. switch on rectifier in OFF position (pointer straight down); plate leads to V–8 through V–11 on exciter disconnected; FILAMENT CONTROL knobs on rectifier and amplifier in extreme counterclockwise position; FILAMENT VOLTAGE knob on exciter in extreme counterclockwise position.

(2) Start equipment by closing FILAMENT switch on exciter.

(3) Advance FILAMENT CONTROL knob on rectifier until FIL. PRIMARY meter indicates 220 volts.

(4) Very gradually, advance FILAMENT CONTROL knob on amplifier to final setting of 22 volts on the FIL. VOLTAGE meter.

Warning: Filament voltage on the amplifier tube builds up slowly because the filament is run from a high-reactance transformer. The FIL. VOLTAGE meter reading will therefore lag several seconds behind sudden application of primary voltage. When the correct setting of the FILAMENT CONTROL knob has been reached, automatically thereafter amplifier filament voltage builds up gradually to 22 volts on sudden application of primary voltage.

(5) Advance FILAMENT VOLTAGE knob on exciter to read 10 volts on FILAMENT VOLTAGE meter of exciter.

(6) Let equipment run for 30 minutes to allow mercury in rectifier tubes to vaporize. This is normal procedure for new rectifier tubes.

(7) After the 30-minute period, stop equipment by opening FILAMENT switch on exciter.

(8) Reconnect plate leads to V–8 through V–11 in exciter. Use GROUND HOOK first.

(9) Leave all switches as they are; the equipment is now prepared for actual tuning.

Section V. TUNING PROCEDURE

27. Exciter Tuning

a. Type of Keying. Radio Transmitters BC–365–A, B, C, D, and E use amplitude (on-off) keying only. Radio Transmitters BC–365–F and above use both amplitude and frequency-shift keying. In frequency-shift keying, carrier power is left on continuously, but carrier frequency is changed a few hundred cycles when the key is closed. *In this tuning procedure, perform all operations with the exciter unit set up for amplitude keying.* If the final type of keying is to be frequency-shift follow the instructions in paragraph 29*e* after complete tuning.

b. Amplifier Settings. Open upper door of amplifier and set GRID FUNCTION SWITCH to TUNE position. Leave door open.

c. Exciter Settings. (1) Start equipment by closing FILAMENT switch.

(2) Set TUNE-OPERATE switch to TUNE position.

(3) Set ANT. COUPLING FINE and ANT. COUPLING COARSE controls to position 6. Set ANT. LOADING to 1, ANT. TUNING A to 0 and ANT. TUNING B to 1 (these are not final settings for these controls).

(4) Set other tuning dials and switches according to figures 4, 5, 6, 7, and 8 of TM 11–828.

(5) Close PLATE switch. Retune I. A. TUNING and POWER AMP. TUNING dials to give maximum dips on corresponding plate current meters.

(6) Set master oscillator frequency exactly with heterodyne frequency meter or crystal calibrator. Retune I. A. TUNING and POWER AMP. TUNING dials again to give maximum plate current dips.

Note. The exciter is now tuned through the plate of its power amplifier stage. The next steps will take it through its output coupling circuit.

(7) Set ANT. LOADING and ANT. TUNING B dials according to table below.

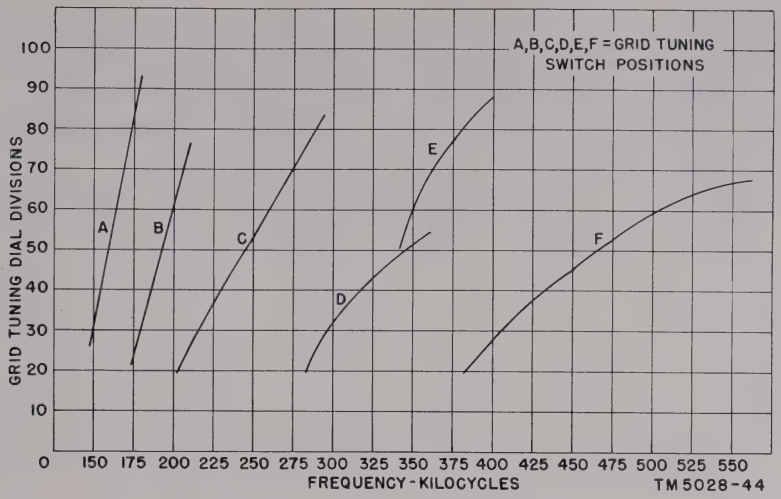


Figure 44. Typical amplifier GRID TUNING curves.

Frequency (kc)	ANT. LOADING	ANT. TUNING B
150–156	3	2
156–166	3	1
166–179	2	4
179–200	2	3
200–220	2	2
220–240	2	1
240–293	1	4
293–350	1	3
350–425	1	2
425–550	1	1

(8) Turn ANT. TUNING A dial slowly for output circuit resonance as indicated by simultaneous rise in POWER AMP. PLATE current and ANT. CURRENT meter readings. The plate current reading will usually be more sensitive.

(9) If no rise in the above currents is observed, throw TUNE-OPERATE switch temporarily to OPERATE and repeat turning ANT. TUNING A dial. If certain that there is no resonance, try settings above and below the setting for ANT. TUNING B knob in table. Different models of the exciter may have different resonance curves for their antenna tuning coils. In extreme cases, try other positions of ANT. LOADING dial as well.

(10) After resonance is reached, throw TUNE-OPERATE switch to OPERATE and observe ANT. CURRENT. Advance ANT. COUPLING FINE and ANT. COUPLING COARSE knobs toward higher numbers until the ANT. CURRENT meter reads about 6 amperes.

(11) Retune ANT. TUNING A dial, looking now for maximum ANT. CURRENT meter reading.

(12) Retune POWER AMP. TUNING dial for maximum dip. The plate current will be higher than in step (6) above because the power amplifier is now loaded.

(13) If after step (12) above the ANT. CURRENT reading is more than 6 amperes, reduce ANT. COUPLING FINE and/or ANT. COUPLING COARSE (by using higher numbers), and retune as in steps (11) and (12). The object of steps (10), (11), and (12) is to secure 6 amperes of ANT. CURRENT reading, using the highest number settings possible for ANT. COUPLING FINE and COARSE.

(14) Exciter tuning is now complete except for later refinements in POWER AMP. TUNING and ANT. TUNING A. Lock other dials and open PLATE switch.

28. Amplifier Tuning

a. Amplifier Grid Settings. (1) Set GRID FUNCTION SWITCH to OPERATE position.

(2) Set GRID TUNING SWITCH according to table below.

Frequency (kc)	GRID TUNING SWITCH
150–177	A
177–207	B
207–287	C
287–350	D
350–390	E
390–550	F

(3) Set GRID TUNING dial according to figure 44.

(4) Close PLATE switch on exciter.

(5) Turn GRID TUNING dial for maximum GRID CURRENT meter reading. This should be between 75 and 100 ma (milliamperes). The lower values of grid current will be obtained at higher frequencies.

(6) Check the reading of the exciter ANT. CURRENT meter with the amplifier grid circuit tuned as in step (5) above. It now should read approximately according to figure 45.

Note. The exciter ANT. CURRENT meter reading must not exceed 9 amperes when driving the amplifier. At 550 kc, it may be necessary to repeat the entire procedure from paragraph 27 through (6) above to limit this current to 9 amperes, using the ANT. COUPLING FINE and COARSE controls on the exciter to secure the proper current. The amplifier GRID CURRENT meter reading may be less than 75 ma when the final adjustment is made; this, however, is unimportant.

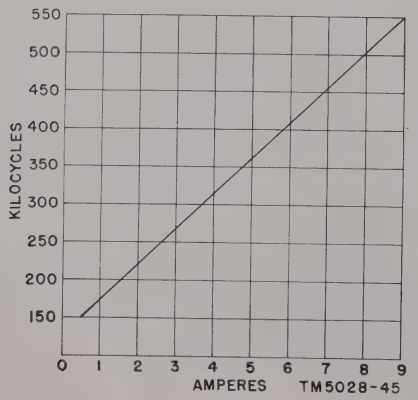


Figure 45. Typical ANT. CURRENT readings on exciter when driving amplifier.

(7) Open exciter PLATE switch when final excitation adjustments have been made.

b. Amplifier Plate Settings. (1) Open NEUTRALIZING LINK.

(2) Set PLATE CAPACITOR LINKS according to table below.

Frequency (kc)	PLATE CAPACITOR LINK		
	A	B	C
150–208	Closed	Closed	Closed
208–288	Open	Closed	Closed
288–400	Open	Open	Closed
400–550	Open	Open	Open

(3) Set HARMONIC COIL TAPS according to table below. Note that the choice of tap at the cross-over frequency 208 kc depends on the PLATE CAPACITOR LINKS.

Frequency (kc)	HARMONIC COIL TAP	
150–170	A	
170–190	B	
190–208	C	PLATE CAPACITOR LINKS A, B, C closed.
208–250	B	PLATE CAPACITOR LINK A open; B, C closed.
250–340	C	
340–460	D	
460–550	E	

(4) Set PLATE COIL TAPS according to table below:

Frequency (kc)	PLATE COIL TAP
150–160	A
160–175	B
175–240	C
240–360	D
360–550	E

(5) Set PLATE TUNING dial according to figure 46.

(6) Close amplifier door.

(7) Close exciter PLATE switch.

(8) Watch the neutralizing indicator through the amplifier door window while slowly turning the PLATE TUNING dial to either side of the position set in step (5) above. Carefully set the dial at the point giving maximum brilliance of the neon lamp.

Note. The next step neutralizes the amplifier stage. The operation is simple but must be done carefully.

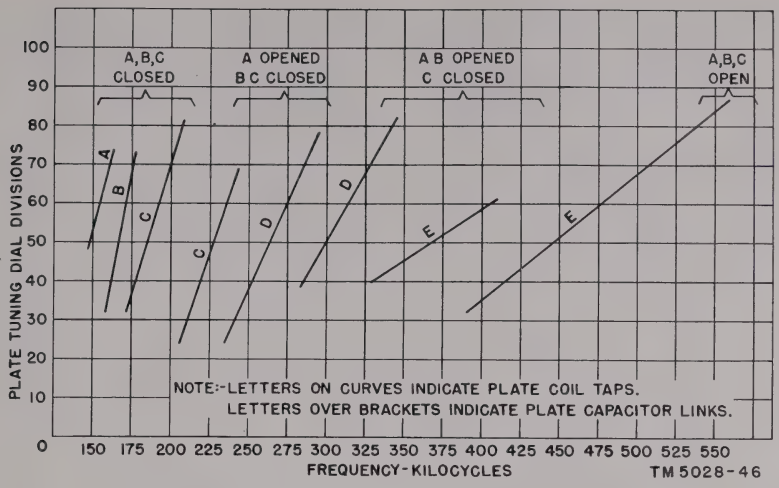


Figure 46. Typical amplifier PLATE TUNING curves.

(9) Watch the neutralizing indicator while slowly turning the GRID TUNING dial to either side of the position set in *a* (5) above. Observe that the neon lamp first glows, then goes out, then glows again, then goes out again (fig. 47). This sequence takes place within a few dial divisions of the original setting. Take careful note of the dial setting at the points where the neon lamp barely lights on either side of the dark interval, and set the dial halfway between those points. The number of dial divisions over which the neon lamp is dark decreases as the frequency increases. It may be 3 or 4 divisions at 150 kc and only 1 or 2 divisions at 550 kc.

(10) After obtaining the proper amplifier GRID TUNING dial setting in step (9) above, it may be necessary to re-resonate the exciter ANT. TUNING A dial for maximum amplifier GRID CURRENT reading. Only a slight adjustment is necessary.

Warning: In the next steps, plate voltage is applied to the amplifier for the first time. Stop the equipment by opening exciter PLATEs witch, upper door on amplifier, and rectifier PRI. VOLTAGE ADJ. switch in that order. Use ground hook first if working inside equipment. Start equipment by reversing above procedure.

(11) Stop equipment.

(12) Set amplifier PLATE VOLTAGE switch to LOW position.

(13) In paragraph 25*a* (6) an average value of line voltage was obtained. Set the rectifier PRI. VOLTAGE ADJ. switch to the tap in the limits of the table in paragraph 25*a* (5). It is understood that the phrase "open PRI. VOLTAGE ADJ. switch" means that the pointer should be straight down and "close PRI. VOLTAGE ADJ. switch" means that the pointer should be set to the tap in use.

(14) Start equipment and note amplifier PLATE CURRENT meter reading. The reading should be low because the plate circuit has already been tuned in step (8) above. Check this by slowly turning the PLATE TUNING dial for maximum dip on PLATE CURRENT meter. The current at maximum dip should be less than 0.1 ampere. Note that the rectifier PLATE VOLTAGE meter reads about 5,200 volts.

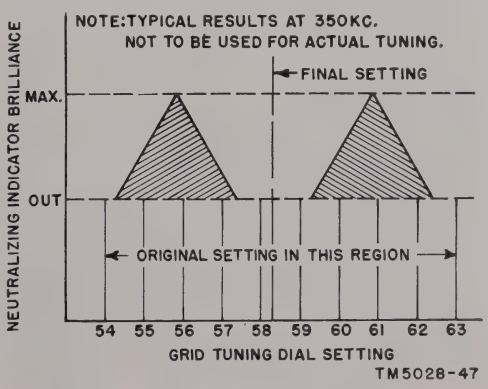


Figure 47. Action of neutralizing indicator.

(15) Tuning of the equipment up to the antenna tuning unit is now complete. Stop the equipment and lock all tuning controls.

(16) Close NEUTRALIZING LINK.

Warning: USE GROUND HOOK FIRST!

29. Antenna Tuning Unit Tuning

Warning: Keep personnel away from the antenna tuning unit during the tuning process. The man performing the tuning procedure at the antenna tuning unit house should keep himself close to the control panel.

a. Introduction. (1) The object of the antenna tuning unit tuning procedure is to resonate the antenna capacity and transform its resistance into 350 ohms to match the transmission line. The antenna capacitance is resonated by means of the *sum* of the inductance of antenna tuning unit coils L–401, L–402, and L–403 (fig. 63). The antenna resistance is transformed by tapping the transmission lines across part of this total inductance by means of the ANT. COUPLING coil L–401. Note that the resistance transformation depends on the inductance of L–401, and resonance depends on the series inductance of all three coils. For this reason the ANT. TUNING and ANT. COUPLING controls are not independent.

(2) There are two methods of antenna tuning unit tuning, depending on whether the antenna characteristics are known or unknown; both methods are described below. Two or three men are required for these operations, one at the antenna tuning unit house and one or two in the transmitter house. Some means of communication between them must be used; for example, temporary field telephone, "walkie-talkie," or, as a last resort, wig-wag signals.

b. Method with Unknown Antenna Characteristics. (1) At the end of paragraph 28, the amplifier was completely tuned on low power. Retain this condition.

(2) Set R. F. LINE AMMETER and ANT. CURRENT AMMETER switches on amlpifier and antenna tuning unit to READ position.

(3) Set ANT. TUNING dial to 100 and ANT. COUPLING dial to 50. Set links on L–402 to short out entire coil (as in fig. 42 and table I).

(4) In this condition the antenna circuits probably will be badly out of tune. This means that the amplifier PLATE CURRENT will be high, because the amplifier output terminals are practically short-circuited. To limit the amplifier PLATE CURRENT to a safe value and prevent tripping of the plate overload relay, proceed as follows: Detune ANT. TUNING A dial on exciter as far as possible. Start equipment. Amplifier PLATE CURRENT and GRID CURRENT will be zero or very low because excitation is missing. Slowly retune ANT. TUNING A dial on exciter to bring up amplifier PLATE CURRENT. R. F. LINE CURRENT will rise at the same time. Bring up the excitation in this way until amplifier PLATE CURRENT reads 0.75 ampere or until R. F. LINE CURRENT reads 7 amperes, whichever happens first.

(5) Resonating the antenna will cause ANTENNA CURRENT to rise. At the same time, R. F. LINE CURRENT will fall, because resonating the antenna causes resistance to be reflected into the transmission line.

(6) Proceed now to resonate the antenna by means of the ANT. TUNING dial, looking for a dip in R. F. LINE CURRENT. If no dip is found, return the ANT. TUNING dial to 100, stop the equipment, and set up L–402 for 10 turns (fig. 42 and table I). Start equipment and repeat

Table I. Antenna loading coil L–402 inductance

Inductance (microhenrys)	Turns	Terminal shorting links
1,400	70	L to L
1,320	68	L to K
1,230	65	L to J
1,190	63	L to I
1,100	60	L to H
1,055	58	L to G
990	55	L to F
940	53	L to E
820	50	L to D
770	48	A to B; L to K
720	45	A to B; L to J
680	43	A to B; L to I
610	40	A to B; L to H
562	38	A to B; L to G
505	35	A to B; L to F
465	33	A to B; L to E
408	30	A to B; L to D
360	28	A to B; B to C; L to K
300	25	A to B; B to C; L to J
265	23	A to B; B to C; L to I
215	20	A to B; B to C; L to H
173	18	A to B; B to C; L to G
130	15	A to B; B to C; L to F
110	13	A to B; B to C; L to E
70	10	A to B; B to C; L to D
0	0	A to B; B to C; C to D; L to D*

*Entire coil shorted out.

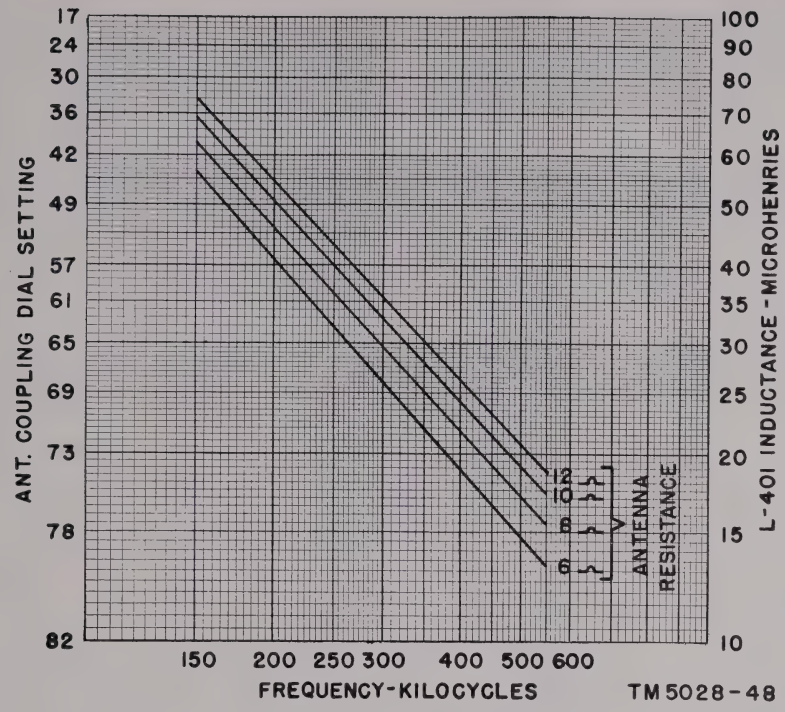


Figure 48. ANT. COUPLING dial settings and inductance of L–401.

resonating with ANT. TUNING dial. It may be necessary to repeat this procedure for every combination of turns in table I until resonance is found. Patience is required. Work systematically, changing L–402 in two- or three-turn steps, working from the bottom up in table I. Arrange taps only as directed in that table; do not try unlisted tap combinations.

(7) When antenna resonance is approached, carefully set the ANT. TUNING dial for maximum dip in R. F. LINE CURRENT. A corresponding dip in amplifier PLATE CURRENT will occur. If the current goes to zero, increase the excitation by bringing the exciter ANT. TUNING A dial closer to resonance, so that enough R. F. LINE CURRENT is obtained for a clearly defined dip.

(8) The antenna is now resonated, but the ANT. COUPLING setting is probably incorrect because at the beginning it was arbitrarily set to 50, representing an average value of coupling. In the next steps, ANT. COUPLING will be adjusted to give the right value of R. F. LINE CURRENT. This current must be obtained with the amplifier excitation restored to its original value.

(9) Bring exciter ANT. TUNING A dial closer to resonance, as indicated by a rise in amplifier GRID CURRENT. At the same time amplifier plate current, antenna current, and r-f line current will rise. If it is possible to bring exciter ANT. TUNING A dial to full resonance without getting more than 7 amperes of R. F. LINE CURRENT, then leave the control at full resonance and lock it. If not, advance the control toward resonance until 7 amperes of R. F. LINE CURRENT is obtained.

(10) If the R. F. LINE CURRENT obtained in step (9) is 7 amperes with exciter ANT. TUNING A dial still not completely resonated, proceed as follows: Turn antenna tuning unit ANT. COUPLING dial counterclockwise about one-eighth turn. Retune antenna tuning unit ANT. TUNING dial in clockwise direction for maximum dip in R. F. LINE CURRENT. (Remember that these dials are interdependent; they track fairly well, but in opposite directions.) R. F. LINE CURRENT will now be lower. Bring exciter

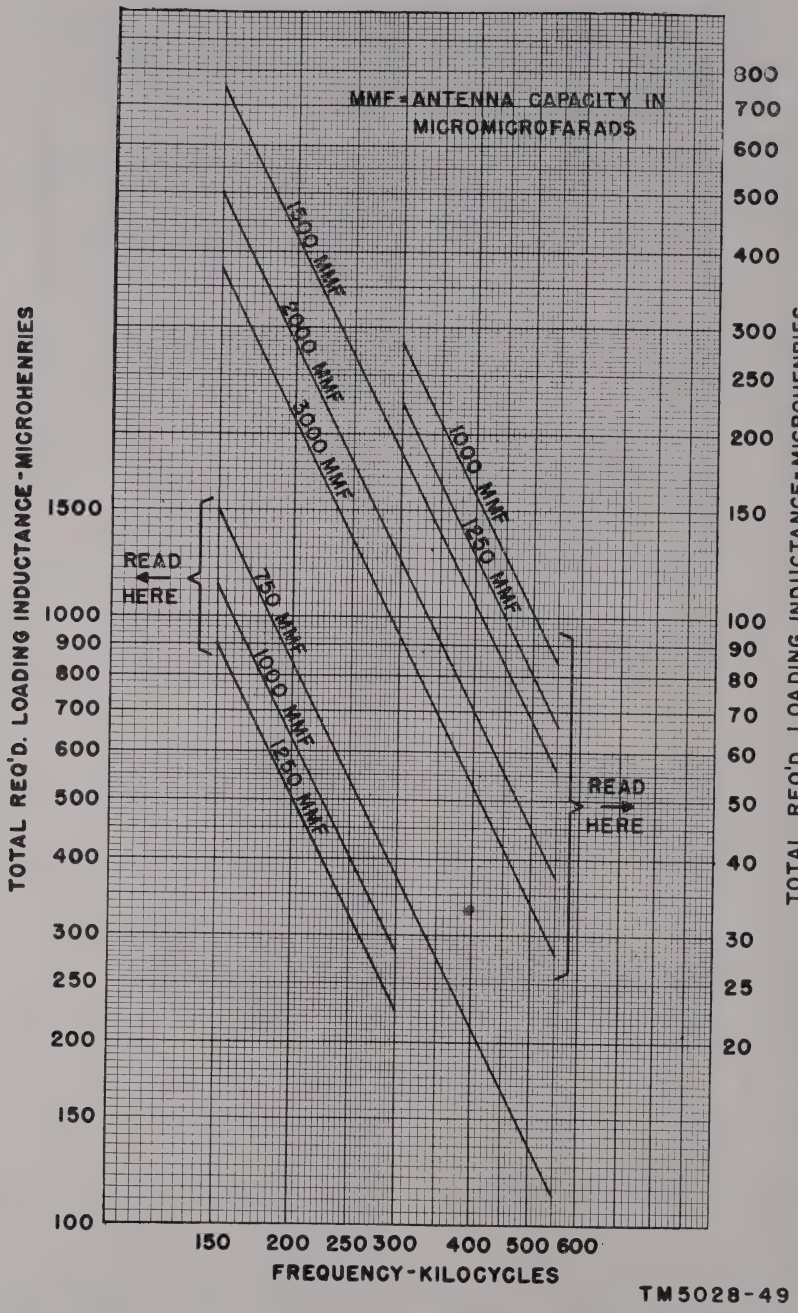


Figure 49. Total required antenna loading inductance.

ANT. TUNING A dial closer to resonance, but not to exceed 7 amperes, as read on R. F. LINE CURRENT meter. Repeat the procedure of this subparagraph until exciter ANT. TUNING A dial is completely resonated and R. F. LINE CURRENT is 7 amperes or less.

(11) The original amplifier excitation has now been restored and R. F. LINE CURRENT may be from nearly zero to 7 amperes. The right value of R. F. LINE CURRENT (for amplifier in low power condition) is 3 amperes. When this value of current is obtained at the dip caused by antenna tuning unit ANT. TUNING dial rotation, the antenna is resonated and the antenna tuning unit is reflecting 350 ohms pure resistance to the transmission line. Correspondingly, the amplifier will be properly loaded.

(12) If the R. F. LINE CURRENT is over 3 amperes, reduce it in the same way as in (10) above; that is, turn ANT. COUPLING dial a small amount in the counterclockwise direction, and retune ANT. TUNING dial in clockwise direction about an equal amount to obtain the R. F. LINE CURRENT dip. Repeat this procedure until the R. F. LINE CURRENT at maximum dip is 3 amperes.

(13) If the R. F. LINE CURRENT is under 3 amperes, increase it as in (12) above, except that the rotation of the dials is reversed; that is, turn ANT. COUPLING dial clockwise and ANT. TUNING dial counterclockwise.

(14) When the R. F. LINE CURRENT maximum at 3 amperes has been reached, stop the equipment and set the amplifier PLATE VOLTage switch to HIGH position. Full plate voltage (about 9,100 volts) will now be available.

(15) Start equipment and observe R. F. LINE CURRENT meter at the antenna tuning unit. It should read 5 or 6 amperes. Refine ANT. COUPLING and ANT. TUNING as in (12) or (13) above until the R. F. LINE CURRENT at maximum dip reads 5.3 amperes at the antenna tuning unit. This is the right value for high power operation. R. F. LINE CURRENT reading at the amplifier may be slightly different.

(16) Note the amplifier PLATE CURRENT reading; it should be about 1.5 amperes. Note the amplifier GRID CURRENT reading; it should be between 50 and 75 ma, the lower values being obtained at the higher frequencies. Note the antenna tuning unit ANTENNA CURRENT reading. This current and the power output depend on the antenna characteristics and operating frequency; no simple data can be given here. However, ANTENNA CURRENT will be between 25 and 40 amperes for any combination of conditions.

(17) The entire tuning procedure is now complete. Lock all tuning controls and set the three r-f ammeter switches to SHORT position. Record the settings at this frequency for future reference. The equipment is now ready for service.

c. Method with Known Antenna Characteristics. This method is exactly the same as the method in *b* above, except that a knowledge of the antenna characteristics permits closer original settings to be made.

(1) Using the known value of antenna resistance and operating frequency, find ANT. COUPLING dial setting from figure 48 and set the dial to this number. Read the corresponding L–401 inductance on figure 48 and record the value; it will be used later. For example, if the antenna resistance is 9 ohms and the operating frequency is 250 kc, the ANT. COUPLING dial setting is 58 and the inductance is 38 microhenrys.

(2) Using the known value of antenna capacity and operating frequency, find the total required antenna loading inductance and record the value. For example, if the antenna capacity at 250 kc is 900 mmf, the total required antenna loading inductance is 460 microhenrys.

(3) The ANT. TUNING coil provides a maximum of 125 microhenrys. The ANT. COUPLING coil provides an additional amount, depending on antenna resistance and frequency. The sum of these subtracted from the total required inductance found in step (2) above is the amount of inductance which must be provided by the tapped loading coil, L–402. In the example so far used, $460-(125+38)=297$ microhenrys needed from L–402. To provide some range for the ANT. TUNING dial, increase this amount to, for example, 340 microhenrys. Call this the required L–402 inductance.

(4) Set up the required L–402 inductance to the nearest value in table I. In the example, 340 microhenrys inductance was required. The nearest value in table I is 360 microhenrys, using 28 turns on L–402 obtained by shorting terminals A to B, B to C, and L to K.

(5) Set ANT. TUNING dial to 100. Proceed now exactly as in *b* (4) through (17) above, except that the number of turns set up on L–402 may

have to be varied above or below the number set up in (4) above. Because of tolerances in the data, it may be necessary to try 10 or 12 turns above and below the number of turns indicated in table I.

d. Typical Tuning Data. Typical tuning data are given in table II. The meter readings data are indicative of tolerable variations which may occur in practice. The antenna tuning unit data are for an antenna of 1,500 mmf and 9 ohms.

Table II. Typical Tuning Data

Note. Line voltage: 200; plate voltage: 8,900; antenna: 1,500 mmf, 9 ohms. Exciter data given here are relevant to amplifier tuning; for balance of exciter data see TM 11-828.

	Frequency (kc)	150	177	208	208	245	288
E	ANT. COUPLING FINE	6	6	6	6	3	3
X	ANT. COUPLING COARSE	6	3	5	5	2	2
C	ANT. LOADING	3	2	2	2	1	1
I	ANT. TUNING A	66	50	39	39	78	32
T	ANT. TUNING B	2	4	2	2	4	4
E	ANT. CURRENT (amp)	0. 5	1. 0	1. 25	1. 25	2. 4	2. 5
R							
A	GRID TUNING SWITCH	A	B	C	C	C	D
M	HARMONIC COIL TAPS	A	B	C	B	B	C
P	PLATE CAPACITOR LINKS	A, B, C closed			A open; B, C closed		
L	PLATE COIL TAPS	A	C	C	C	D	D
I	GRID TUNING	30	35	24	25	, 52	25
F	PLATE TUNING	53	42	77	29	33	74
I	GRID CURRENT (ma)	70	78	61	61	73	56
E	PLATE CURRENT (amp)	1. 4	1. 5	1. 54	1. 45	1. 5	1. 56
R							
A	ANT. COUPLING	38	44	52	52	58	63
N	ANT. TUNING	33	38	36	36	36	19
T	L-402 turns	40	30	23	23	18	10
	R. F. LINE CURRENT (amp)	5. 2	5. 4	5. 4	5. 2	5. 2	5. 4
T	ANTENNA CURRENT (amp)	30	30	30	30	30. 5	30. 5
U							
N							
I							
N							
G							
U							
N							
I							
T							

Table II. Typical Tuning Data—Continued

	Frequency (kc)	288	366	400	400	468	550
EXCITER	ANT. COUPLING FINE	3	2	2	6	6	6
	ANT. COUPLING COARSE	2	2	2	1	2	2
	ANT. LOADING	1	1	1	1	1	1
	ANT. TUNING A	32	55	37	37	52	12
	ANT. TUNING B	4	2	2	1	1	1
	ANT. CURRENT (amp)	2. 5	7. 5	6. 8	8. 0	8. 8	9. 0
AMPLIFIER	GRID TUNING SWITCH	D	E	F	F	F	F
	HARMONIC COIL TAPS	C	D	D	D	E	E
	PLATE CAPACITOR LINKS	A, B open; C closed			A, B, C open		
	PLATE COIL TAPS	D	E	E	E	E	E
	GRID TUNING	25	70	28	28	50	60
	PLATE TUNING	43	49	58	35	56	83
	GRID CURRENT (ma)	55	68	53	64	65	50
	PLATE CURRENT (amp)	1. 48	1. 5	1. 55	1. 46	1. 55	1. 55
ANT TUNING UNIT	ANT. COUPLING	63	68	71	71	73	76
	ANT. TUNING	19	18	30	30	44	57
	L–402 turns	10	zero	zero	zero	zero	zero
	R. F. LINE CURRENT (amp)	5. 2	5. 3	5. 3	5. 3	5. 4	5. 4
	ANTENNA CURRENT (amp)	30. 5	31	31	31. 5	32	32

e. Frequency-Shift Keying. If frequency-shift keying is to be used, some slight refinements in the procedure must be added. After the entire equipment is satisfactorily tuned, proceed as follows:

(1) Set AMPL.-FREQ. switch on exciter to FREQ. position.

(2) Set PLATE VOLTAGE switch on rectifier to LOW position.

(3) Start equipment.

(4) Using a hand key, set the carrier and frequency shift precisely, following the instructions in TM 11–828. Do not re-resonate any other circuits.

(5) Check the ANTENNA CURRENT meter reading on the antenna tuning unit for key-up and key-down positions. At low frequency with a low-resistance high-capacity antenna there may be a noticeable difference in current due to the high Q of the antenna circuit. Detune the ANT. TUNING control very slightly so that the same current is obtained with key up or key down. This current may be slightly less than the value obtained with accurate tuning at one frequency because the antenna circuit is now resonant at the average of the carrier and shifted frequencies. The R. F. LINE CURRENT meter reading may be slightly higher now but should also read the same key up or key down.

(6) If a high-speed machine keyer is available, the averaging operation in (5) above may be done more easily. Arrange the keyer to operate continuously at high speed; then retune the ANT.

TUNING control very slightly to give maximum ANTENNA CURRENT. This will correspond to a slightly higher maximum dip in R. F. LINE CURRENT. The inertia of the meters automatically averages the key-up and key-down currents, so that comparison is unnecessary.

Section VI. OPERATION UNDER UNUSUAL CONDITIONS

30. Equipment Failure

a. Amplifier or Rectifier Failure. If a failure in either the amplifier or rectifier causes the equipment to go off the air, the exciter can be made to feed the transmission line and antenna system without retuning of the antenna tuning unit. Two or three hundred watts of output can be realized for emergency service.

(1) Set GRID FUNCTION SWITCH on amplifier to EMERGENCY position.

(2) Set EMERGENCY TUNING SWITCH on exciter according to table below.

Frequency (kc)	Emergency tuning switch
150–170	A
170–200	B
200–240	C
240–280	D
280–400	E
400–550	F

(3) Follow instructions in TM 11–828 to tune the exciter. The load on the exciter with the GRID FUNCTION SWITCH in EMERGENCY POSITION is that of an antenna of 1,500 mmf capacity and about 9 ohms resistance.

Warning: Do not perform service work on the amplifier or rectifier during emergency operation because the amplifier grid circuit will be at high voltage and the door interlocks must be shorted. Wait for an off period.

b. Amplifier Blower B–201 Failure. If amplifier blower B–201 fails, air interlock switch S–208 will not close and the equipment will not operate. Operation at reduced power can be had as follows:

(1) Replace amplifier blower B–201 with rectifier blower B–301. The blowers are interchangeable subassemblies. Change them by removing the four screws which hold the subbase to the equipment. Do not remove the blower from the subbase. The blower subassembly as a unit is shown in figure 54.

(2) Tape up the ends of the three wires removed from rectifier blower B–301 to insulate them from each other and from the chassis.

(3) Set rectifier PLATE VOLTAGE to LOW position and operate equipment. If the amplifier blower turns backwards, reverse any two wires on the blower terminal board. Power output in this condition of operation is about one-third of normal.

Warning: Never attempt to operate the equipment without an amplifier blower or by tampering with air interlock switch S–208. Insufficient cooling air for V–201 (Tube JAN–891R) means complete destruction of the tube in a short time.

31. Unusual Temperature

The equipment is designed to operate in an air conditioned room maintained between 15° C. and 50° C. (59° F. and 122° F.). Emergency operation beyond these extremes is permissible as described below.

a. Below 15° C. (59° F.). (1) Full-power operation down to 5° C. (41° F.) is permissible but may be accompanied by shortened rectifier tube life.

(2) Operation below 5° C. (41° F.) is not permissible except for extreme emergency. In this case, disconnect rectifier blower B–301 and allow the tubes to run with filament ON but with no plate voltage as long as practicable before transmission is necessary.

b. Above 50° C. (122° F.). (1) Operation from 50° C. (122° F.) to 65° C. (149° F.) is permissible only if the rectifier PLATE VOLTAGE switch is set to LOW position.

(2) Operation above 65° C. (149° F.) is not permissible except for extreme emergency conditions. Operate at low power as in (1) above. There will be constant danger of interruption due to the possibility of flashbacks in the rectifier tubes.

PART THREE
MAINTENANCE INSTRUCTIONS

Section VII. SPECIAL ORGANIZATIONAL TOOLS AND EQUIPMENT

(None required.)

Section VIII. LUBRICANTS

(None required. No lubrication orders apply.)

Section IX. PREVENTIVE MAINTENANCE SERVICES

32. Periodic Service on Amplifier Assembly AN/FRA–1A

Item	Service	Interval	Subpar. ref. below
1	Check filament voltage and line voltage	Daily	*a*
2	Take meter readings	Daily	*b*
3	Check dial settings and locks	Daily	*c*
4	Clean air filters	As required	*d*
5	Clean and tighten outdoor insulators (transmitter house, transmission line, antenna tuning unit).	As required	*e*
6	Clean and tighten indoor insulators (transmitter house, equipment, antenna tuning unit).	Monthly	*f*
7	Clean and tighten shaft couplings	Monthly	*g*
8	Clean relays	Monthly	*h*
9	Tighten blowers	Monthly	*i*
10	Clean V–201	Monthly	*j*
11	Change tubes	As required	*k*
12	Check spark gaps	Monthly	*l*

a. Filament Voltage and Line Voltage. (1) Carefully set filament voltages at least once daily. If there are regular fluctuations in line voltage due to other loads and power source regulation, more frequent checks may be necessary.

(2) If the line voltage fluctuates greatly, and manual or automatic regulation is impracticable, note the average daily line voltage on phase 1–2. Set the rectifier FILAMENT CONTROL to read 220 volts on the FIL. PRIMARY meter and the amplifier FILAMENT CONTROL to read 22 volts on the FIL. VOLTAGE meter, *when the line voltage on phase 1–2 is equal to the average daily line voltage.*

(3) Check setting of BIAS RECTIFIER PRIMARY SWITCH according to paragraph 25*a* (5), and check of PRI. VOLTAGE ADJ. switch according to paragraph 25*a* (6).

b. Meter Readings. (1) Record all meter readings daily.

(2) In a varied climate, particular note should be made of meter readings and tuning of the antenna tuning unit when the equipment is first put into service. Relate this to humidity conditions (dry, damp, rain) because it may be necessary to modify the antenna system if its resistance is affected by humidity; for example, when the antenna tuning unit ANT. TUNING control is retuned to give maximum dip on the R. F. LINE CURRENT meter and the resultant maximum dip current is different.

c. Dial Settings and Locks. Check daily for unintentional changes or loosening.

d. Air Filters. (1) Air filters of the oiled wire mesh type are on the lower right side of the ampli-

fier and upper left side of the rectifier. These filters can be cleaned.

(2) Clean air filters before there is any noticeable uncertainty in the action of air interlock switch S–208. Under average dust conditions, clean air filters every 200 hours of blower operation.

(3) Clean filters by washing in Solvent, dry cleaning (SD) and blowing compressed air through the mesh. Recharge filters by dipping in light engine oil (Oil, engine, OE–10). Stand them vertical for 1 hour to drain; then replace them in equipment.

e. Outdoor Insulators. Clean outdoor insulators on transmitter house, antenna tuning unit, and transmission line when they show concentrations of dirt. First wipe with a damp cloth; then polish with a clean, dry cloth to leave insulators dry and with no streaks. Tighten connections.

Note. Avoid overtightening screws in ceramic insulator assemblies. Where electrical connections are made to ceramic posts or feed-throughs, the lugs or wires are always clamped between nuts, never between the ceramic part and the metal hardware. Therefore the electrical connections can always be made tight without putting stress on the ceramic.

f. Indoor Insulators. Clean and tighten indoor insulators monthly. See *e* and the note above.

g. Shaft Couplings. Clean and tighten ceramic-insulated shaft couplings monthly and before each tune-up operation. Give special attention to the shaft couplings on the antenna tuning unit ANT. TUNING and ANT, COUPLING controls.

h. Relays. (1) Clean contacts monthly. Black oxide discoloration of the silver contacts is normal and permissible, but remove high spots, pitting, and burned areas. Use No. 0000 sandpaper to remove high spots and to smooth pitted areas; then burnish with relay burnishing tool or crocus cloth.

(2) Use compressed air, a fine brush, or a lint-free cloth to remove dust and particles from working parts of relays. Relay chattering is often caused by dirt between pole faces or dirt trapped in working parts.

i. Blowers. (1) Remove air filters to expose blower wheels. Tighten setscrew on hub of blower wheel monthly.

(2) The blower motors have permanently lubricated and sealed ball-bearings; no lubrication is possible or necessary. Replace entire motor when bearings are so worn that side-play in the shaft is noticeable.

j. Amplifier Tube. (1) Remove V–201 and clean out dirt in fins monthly. Use a pipe cleaner or stiff wire to break up the hardened dirt toward the inside of the fins; then blow through with compressed air.

(2) Clean inside of ceramic shell of V–201 mounting before replacing tube.

k. Changing Tubes. (1) Keep a log of filament hours for each tube by noting the FILAMENT HOURS meter reading at the time of installation of the tube.

(2) Change tubes in accordance with applicable regulations.

(3) When a new mercury vapor tube (Tube JAN–575A or JAN–866A/866) is installed, allow the filaments to run for 30 minutes before applying plate voltage. To do this, open a door on the amplifier and then start the equipment in the normal way.

(4) When a new amplifier tube (Tube JAN–891R) is installed, allow the filaments to run for 10 minutes before applying plate and grid voltage. Then apply low plate voltage and normal grid excitation for 15 minutes. After that, apply high plate voltage for full output. If flash-arcs occur, evidenced by tripping plate overload relay and reversed grid current, operate for a longer period at low plate voltage and again apply full plate voltage. This treatment frequently restores the tube to normal operation.

l. Spark Gaps. Check spark gap distances monthly according to paragraph 19*i* and tighten clamps.

m. Radio Transmitter BC–365–( ). For preventive maintenance services to be performed on Radio Transmitter BC–365–( ) use applicable items in the subparagraphs above; also see TM 11–828, section D.

33. Weatherproofing

a. Tropical Operation. Amplifier Assembly AN/FRA–1A is protected against deterioration under tropical climatic conditions by a moisture-proofing and fungiproofing varnish treatment applied at the time of manufacture. TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment, provides adequate instructions for field and base maintenance re-treatment of the equipment.

b. Desert Operation. Precautions to prevent equipment failure due to dust or dirt infiltration, as outlined in TB SIG 75, Desert Maintenance of Ground Signal Equipment, are adequate for Amplifier Assembly AN/FRA–1A.

c. Arctic Operation. Amplifier Assembly AN/FRA–1A will perform satisfactorily under low operating conditions; however, in placing this equipment in use at low temperatures, always allow the maximum possible warm-up time prior to operation. If possible, the equipment should be allowed to stand with the power off, in a heated shelter, before operation. For additional information on low-temperature operation, refer to TB SIG 66, Winter Maintenance of Signal Equipment. Also see paragraph 31.

813249—48——5

PART FOUR

EQUIPMENT USED IN CONJUNCTION WITH AMPLIFIER ASSEMBLY AN/FRA–1A

34. Radio Transmitter BC–365–( )

Use of Radio Transmitter BC–365–( ) in conjunction with Amplifier Assembly AN/FRA–1A has been explained elsewhere in this manual and through reference to TM 11–828.

PART FIVE

TECHNICAL SERVICE MAINTENANCE INSTRUCTIONS

Section X. GENERAL

35. General

Amplifier Assembly AN/FRA–1A is an r-f amplifier designed to be excited from Radio Transmitter BC–365–( ). It provides 6 to 10 kw of power output into an antenna system having 750 to 3,000 mmf capacity and 6 to 12 ohms resistance over the range 150 to 550 kc. The emission is radio telegraphy only, with either amplitude or frequency-shift keying up to 200 words per minute. The equipment is designed for fixed service and cannot readily be disassembled and transported. The trouble-shooting and repair instructions which follow are intended for the highest level of skill and equipment available at the installation.

Section XI. THEORY OF OPERATION

36. Radio-Frequency Circuits (figs. 50, 63, and 64).

a. Basic Circuit (fig. 50). (1) The amplifier uses a single forced-air-cooled high-power triode tube (V–201, JAN–891R) as a class C amplifier excited by the output of Radio Transmitter BC–365–( ). The exciter is designed to operate into an antenna of 750 to 3,000 mmf capacity and 6 to 12 ohms resistance over the range 150 to 550 kc. The output circuit of the exciter is a pi-network comprised of plate variometer L–11, tank capacitors C–38, C–39, and C–41, and load capacitors C–42, C–45, C–46, C–55, C–56, and C–57. The tuning range is largely determined by the tap on L–11 and by switching the tank capacitors. The loading is varied largely by switching the load capacitors. To resonate the antenna and put a resistive load across the load capacitors, loading variometer L–12 is used. (See TM 11–828).

(2) To use the output circuit of the exciter without changes, and to permit easy tuning, grid function switch S–205 in the amplifier operates as follows: In the TUNE position a dummy load consisting of a bank of noninductive resistors R–220 through R–227 (8 ohms total) in series with capacitor C–228 (1,500 mmf) is connected across the output of the exciter. The exciter can then be tuned normally. The r-f voltage built up across C–228 is approximately the right amount for driving the grid of V–201.

(3) In the OPERATE position of S–205, dummy load resistors R–220 through R–227 are disconnected and dummy load capacitor C–228 is connected in series with exciter loading variometer L–12 to ground. At the same time, the amplified grid tank consisting of variometer L–201 and tank capacitors C–201 through C–203 and C–227 is connected to C–228. When the grid tank is tuned to resonance, the exciter is working into a load which duplicates that of the specified antenna.

(4) The grid tank circuit is balanced to ground, one side feeding the grid of V–201, the other side connected to the plate of V–201 through the fixed neutralizing capacitor C–206. This is a conventional method of grid-neutralizing but is not complete, particularly at the higher frequencies, because of unbalances introduced by tube and stray capacities. Perfect neutralizing is obtained by deliberate slight mistuning of L–201, compensated by retuning of L–11 in the exciter (par. 28*b*). Neon lamp I–205 is a visual indicator which is used in this process.

(5) The plate tank of the amplifier is a pi-network consisting of plate variometer L–206, tank capacitors C–208 through C–213, and load capacitors C–216 through C–219, C–232, and C–233. The tank and load capacitors are switched in banks by mechanically coupled links. The capacitors are chosen and switched in banks to provide almost constant operating tank Q over the frequency range of the equipment. The ratio

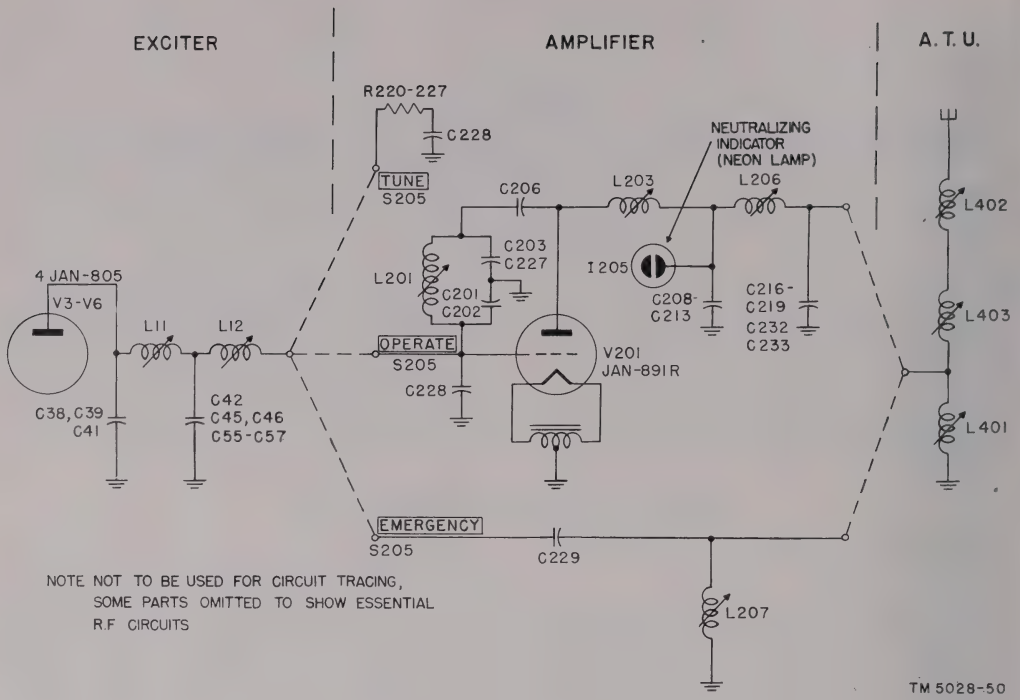


Figure 50. R-f circuit functional schematic.

of tank capacity to load capacity is such that a 350-ohm resistive load connected across the output loads the amplifier to an almost constant power output of 10 kw over the frequency range. Note that there is no output coupling adjustment. The coupling is determined solely by the ratio of tank capacity to load capacity, and this is fixed because the capacitors are fixed and switched in definite amounts to preserve the ratio giving 10 kw output.

(6) Antennas used with low-frequency equipment of this type generally are less than one-quarter wavelength long. Physically, they usually are either a vertical steel tower insulated at the base or an inverted L wire antenna. At the base of the tower, or at the down lead of the inverted L, such antennas may be thought of simply as a capacity in series with a resistance. The capacity is the capacity of the tower or wire to earth, and the resistance represents the "losses" of the capacity—that is, the power radiated into space as signals. For an antenna of given size, the capacity and resistance increase with frequency until the antenna is one-quarter wavelength long, at which point the antenna capacity becomes infinite and its resistance is about 35 ohms. Antennas used with Amplifier Assembly AN/FRA–1A will never reach this condition. Their capacity will vary between 750 and 3,000 mmf, and their resistance between 6 and 12 ohms. In order to use such an antenna effectively, it is necessary to resonate its capacity. This is done by placing an inductance (usually called loading coil) in series with the antenna and earth. Adding inductance in series with the antenna effectively increases the length of the antenna. Adding the right inductance increases its length (electrically, not physically) to one-quarter wavelength. The sum of the inductances of L–401, L–402, and L–403 in the antenna tuning unit does this. In addition, the antenna tuning unit must present a resistive load of 350 ohms to the transmission line. This is done by means of L–401, which effectively taps a portion of the total inductance. The ratio of L–401 inductance to total inductance transforms the antenna resistance to 350 ohms.

(7) The operating tank Q of the amplifier is low (about 6 to 7.5). For this reason, harmonic coil L–203 is used in series with the plate tank. L–203 is roughly tuned to resonate with the capacitive reactance of the tank circuit at the second harmonic of carrier frequency. This attenuates the second harmonic of tank voltage and improves the efficiency of the amplifier.

(8) With S–205 in EMERGENCY position, the output of the exciter is connected in series with capacitor C–229 (1,500 mmf, same as C–228) and emergency coil L–207 to ground. At the same time the transmission line is connected across L–207. By choosing the proper tap on L–207 and retuning the output circuit of the exciter, the transmission line is transformed to a pure resistance between 6 and 12 ohms. The exciter therefore operates normally, and the existing transmission line and antenna system can be used for emergency service.

b. Details (fig. 64). (1) S–221 is a tap switch for changing inductance of L–207. S–210 selects combinations of grid tank inductance and capacity in proper proportions to cover the frequency range.

(2) C–204 and C–207 are the grid and plate blocking capacitors, respectively. L–208 and L–202 are the grid and plate shunt-feed r-f chokes, respectively. C–205 and C–220 bypass the cold ends of L–208 and L–202, respectively. R–202 and R–203 are the grid bias resistors.

(3) L–209 in shunt with R–217 forms a parasitic suppressor in the grid circuit.

(4) R-f line current at the amplifier is read on M–203. Switch S–201 connects M–203 in series with the transmission line in the READ position and removes it in the SHORT position, closing the gap at the same time. This switch makes before breaks; the meter is not actually shorted. Similarly, M–402 is switched by S–402 to read r-f line current at the antenna tuning unit, and M–401 is switched by S–401 to read antenna current (fig. 63). TC–401 is a remote thermocouple which actuates M–401 and is bypassed by C–401.

(5) Amplifier filament voltage, grid current, and plate current are read by M–204, M–201, and M–202, respectively (fig. 64). These meters are bypassed by C–226, C–224, and C–225, respectively. M–202 actually is connected in the filament return of V–201, but it reads plate current rather than cathode current because M–201 is connected so that the grid current is automatically subtracted.

37. Power Circuits

a. Plate Voltage Rectifier (fig. 65). (1) The plate rectifier, located in the rectifier unit, is a three-phase full-wave bridge. A-c (alternating-current) plate voltage in three phases is supplied by separate interchangeable transformers T–301 through T–303. The rectifier tubes are V–301 through V–306 (tubes JAN–575A). V–301 through V–303 are supplied by separate filament transformers T–304 through T–306, respectively. V–304 through V–306 are supplied by a common filament transformer, T–307. The primaries of the filament transformers are connected in parallel to a common variac, T–308. Filament primary voltage is read on M–303, and filament running hours, on M–302.

(2) The output of the plate rectifier is filtered by a choke input filter comprised of L–301 and C–301. The charging current of C–301 is limited by R–301 through R–303, which are shorted out by the contacts of relay K–306. The coil of K–306 is operated from an auxiliary pair of contacts on plate relay K–305.

(3) The bleeder resistor for the plate rectifier is comprised of resistors R–306 through R–328 in series. Plate voltage is read on M–301 through external multipliers R–334, R–338, and R–339. Resistor R–340 shunts M–301 to protect the wiring in case M–301 should open.

(4) The plate rectifier negative is returned to ground through potentiometer R–335, which adjusts the trip current of plate overload relay K–307.

(5) Plate primary voltage is adjusted by tap switch S–303 to nominal 200/220/240 volts. S–303 also has an off position. Low-high plate voltage is controlled by S–305, which changes the primary connection from "wye" (low) to "delta" (high).

(6) Line voltage is read on M–304, which is switched to all phases by S–310. General cooling is provided by blower B–301.

b. Bias Voltage Rectifier (fig. 64). (1) The bias rectifier, located in the amplifier, is a single-phase full-wave rectifier. A-c plate voltage is supplied by T–201 and rectified by V–202 and V–203 (Tube JAN–866A/866). V–202 and V–203 filaments are supplied by transformer T–202. The output of the bias voltage rectifier is filtered by a choke-input filter consisting of L–205 and C–223. A bleeder consisting of R–204 through R–210 is connected across the output. R–210 is a poten-

tiometer which sets the operating current through bias interlock relay K–201. Failure or drop in output of the bias rectifier causes K–201 to open and thereby remove plate voltage.

(2) Bias rectifier primary voltage is adjusted by tap switch S–219 to nominal 200/220/240 volts. Both T–201 and T–202 are so adjusted.

38. Control Circuits

a. Starting. (1) In normal operation, MAIN LINE breaker S–301, rectifier FILAMENT breaker S–302, amplifier FILAMENT breaker S–207, and BIAS breaker S–202 are all closed. Meter illuminating lamps I–202, I–203, I–303, and I–304 (figs. 65 and 66) will light.

(2) Assuming a fresh start and when all the above switches are closed, blower delayed-release relay K–203 will close through the normally closed contact of blower delayer-delease timer K–205 and blower B–201 will operate. At the same time, the motor of K–205 will operate, and, if nothing else is done meanwhile, the contacts of K–205 will open after 5 minutes, K–203 will open, and B–201 will stop.

(3) The MAIN LINE breaker of the exciter is assumed to be closed. The equipment is now started either locally or remotely by closing the filament primary circuit of the exciter.

(4) Closing the filament primary circuit of the exciter energizes the motor of control timer relay K–301. After about 2 seconds, an intermittent contact on K–301 is closed and then opened. In its closed interval, auxiliary control relay K–302 is energized. K–302 is kept energized after the momentary contact of K–301 opens by means of applying coil voltage through a normally open contact on K–302 (conventional lock-up or three-wire control). This contact on K–302 is connected in series with a normally closed contact on plate overload relay K–307.

(5) After about 11 seconds running time on control timer K–301, a contact on K–301 closes and remains closed. In turn, rectifier filament relay K–303 is energized, causing blower B–301 to operate, the rectifier filament primary circuit to be energized, and filament indicator I–302 (through series dropping resistor R–337) to light. At the same time, blower auxiliary relay K–204 operates, causing blower relay K–203 to close and B–201 to run. This happens regardless of the position of blower delayed-release timer K–205. If B–201 already is running because 5 minutes have not elapsed, it will continue to run after the 5 minutes are up because the contact of K–205 is shunted by the contact of K–204.

(6) Running of blower B–201 causes air interlock switch S–208 to close, thus energizing amplifier filament relay K–202. This energizes amplifier tube V–201 filament variac T–203 and filament transformer T–204, and filament indicator I–201 lights up (through series dropping resistor R–216). At the same time, a normally closed contact on K–202 opens the circuit to the motor of K–205. K–205 then recycles to its starting position in readiness for a 5-minute overrun on the next shutdown.

(7) Closing of amplifier filament relay K–202 also applies power to bias rectifier filament transformer T–202 and plate time delay relay K–304, through BIAS breaker S–202. After 45 seconds, K–304 closes and energizes bias rectifier plate relay K–206 through door interlock switches S–311, S–307, S–204, and S–218. In turn, primary power is applied to bias plate transformer T–201 and bias indicator I–204 (through series dropping resistor R–219).

(8) Bias bleeder current energizes bias interlock relay K–201, which completes the circuit to the coil of plate relay K–305 through a normally closed contact on plate overload relay K–307. Plate relay K–305 closes and applies primary voltage to plate rectifier transformers T–301 through T–303 through S–303 and S–305, and also lights plate indicator I–301 (through series dropping resistor R–336). When K–305 closes, an auxiliary contact energizes filter capacitor relay K–306, thus shorting out the filter capacitor charging resistors (par. 37*a* (2)).

(9) Starting is now complete. Transmission is obtained by keying the exciter.

b. Stopping. (1) In normal operation, stopping is done by opening the filament circuit of the exciter either locally or remotely.

(2) Opening the filament circuit of the exciter de-energizes the motor of control timer relay K–301, causing it to recycle to starting position. The 11-second delayed contact on K–301 opens, causing rectifier filament relay K–303, blower auxiliary relay K–204, and amplifier filament relay K–202 to open. All transformer primaries and indicator lights are de-energized. Filter capacitor relay K–306 opens, and plate time delay relay K–304 recycles.

(3) Blower relay K–203 remains closed and blower B–201 runs because K–203 is kept ener-

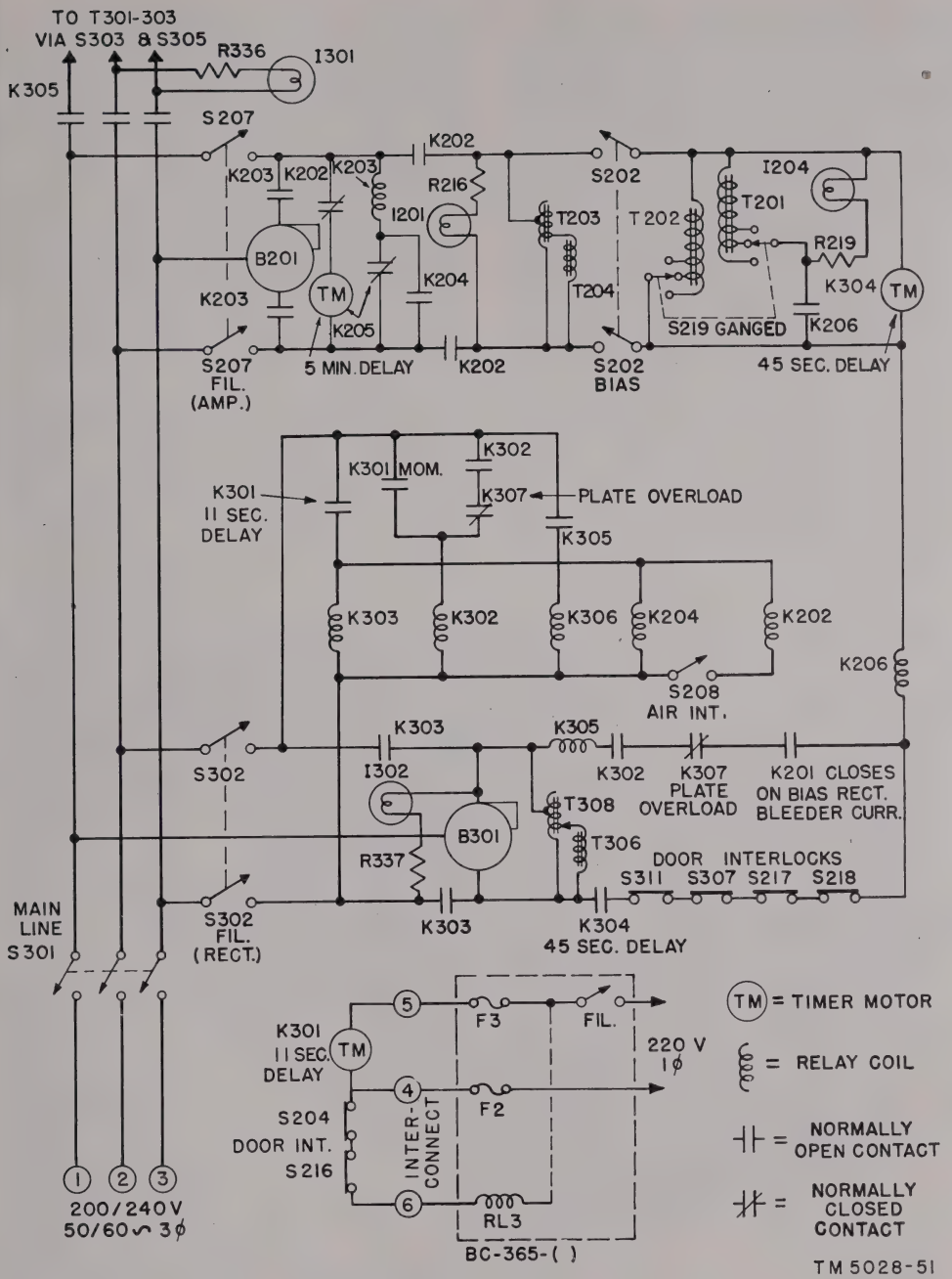


Figure 51. Control circuit functional schematic.

gized through the normally closed contact of blower delayed-release timer K–205. After 5 minutes, the contact of K–205 opens; K–203 thereby opens and B–201 stops. The motor of K–205 remains energized and in locked rotor condition to hold its contact open until the next starting sequence.

(4) Auxiliary control relay K–302 remains closed. In normal operation, K–302 is opened only by operation of plate overload relay K–307, one contact of which (normally closed) is in series with the lock-up contact of K–302. This assumes an original start with either S–301 or S–302 open. On restarting under the above conditions, the momentary delayed contact on K–301 serves no purpose.

c. Protective Action of Control Circuit. (1) Any overload which causes plate overload relay K–307 to operate will break the holding circuit of auxiliary control relay K–302, causing the plate and grid rectifier primary circuits to be de-energized. The filament and blower circuits will be unaffected.

(2) After the fault has been cleared, plate and grid voltage can be applied only if the equipment is stopped and started again after about 3 seconds. The lapse is required to permit K–301 to recycle past the momentary contact point, so that K–302 can be locked again.

(3) Likewise, operation cannot be resumed without restarting if S–301 or S–302 is opened.

(4) Door interlock switches S–216 and S–217 are ganged mechanically to S–218 and S–204, respectively. Hence, opening any door on the amplifier removes high voltage. *However, opening a door on the exciter removes exciter high voltage only.* This is an important point to remember.

(5) Operation of the plate overload relay in the exciter does not require restarting the whole equipment.

(6) The primary circuits are protected as follows: S–301 is an over-all thermal and magnetic breaker; S–302 is a thermal breaker for the rectifier filament circuit; S–207 is a thermal breaker for the amplifier filament circuit; and S–202 is a thermal breaker for the bias rectifier primaries.

39. Miscellaneous Protection (figs. 63, 64, and 65)

High-voltage points in the equipment are protected by spark gaps as follows: G–201 from V–201 grid to ground; G–205 from neutralizing end of grid tank to ground; G–203 from plate tank capacitors to ground; G–204 from plate load capacitors to ground; G–202 from high-voltage feed of V–201 to ground; G–301 across plate rectifier filter choke L–301; G–401 from transmission line to ground at antenna tuning unit; and G–402 from antenna output stud to ground. Resistors R–218 and R–201 limit plate current in the event of short or loss of bias in V–201. High-voltage grounding door switches S–203 and S–220 short-circuit the high voltage through limiting resistors R–211 through R–213; similarly S–309 and S–312 short-circuit the high voltage through resistors R–329 through R–331.

Section XII. PREREPAIR PROCEDURES

40. Test and Repair Equipment

Warning: Operation of this equipment involves the use of HIGH VOLTAGES which are DANGEROUS TO LIFE. Safety regulations must be observed.

a. Tools. (1) No special tools are required for replacing any components of this equipment. Ordinary hand tools will suffice. These should include the following:

Screw drivers.
Socket wrenches.
Open-end wrenches.
Allen wrenches.
Long-nose pliers.
Sidecutters.
Drift pin (1/16-inch diam.).
Soldering iron.
Lamp and extension cord.
Mirror.

(2) Rebuilding most of the components of this equipment is not possible. If repairing litz-wound r-f coils is within the scope of the available maintenance personnel, a motor-driven enamel-stripper is required. Any other machine shop operations can be handled by ordinary machine tools.

b. Instruments. Frequency measuring equipment for the exciter is specified in TM 11–828. For over-all servicing, Test Unit I–176, or equal, will suffice. Such a voltmeter normally is issued separately to each installation.

Warning: Do *not* measure high voltages with this unit; use the panel meters on the equipment.

c. Power Requirements. This equipment ordinarily will be repaired and tested at its installation site. The only source of power required is that necessary to operate the equipment: 200/240 volts ac, 50/60 cycles, 3-phase, 70 amperes minimum current capability per phase.

41. Inspection, Cleaning, and Lubricating

a. Salvageable Components. Defective meters and relays in general can be repaired if there is no great mechanical damage. Defective oil-filled units such as T–301 through T–303 and L–301 can be drained and rewound. Solenoid r-f coils with burned or shorted windings can be rewound if the proper wire is available. Defective Tubes JAN–891R are valuable because of their heavy copper fin structures and should be returned through channels. Blower motors with worn bearings or burned-out windings can be repaired. The extent to which any of these items is salvageable depends on available services and facilities. Figures 52 through 62 show locations of various parts in the amplifier assembly.

b. Unsalvageable Components. Defective resistors, capacitors, potted transformers, and ceramic insulators are, in general not worth repairing. Cracked insulators on potted transformers are difficult to replace but do not necessarily make the component useless.

c. Cleaning and Lubricating. The requirements of paragraph 32 are sufficient for technical service. No lubrication is required.

42. Stripping

Most of the components in this equipment are readily accessible, and the method of removal is obvious. Trouble shooting can be done without major disassembly to the extent necessary to find the cause of the trouble. A few special stripping techniques are given in this paragraph.

a. Bias Rectifier (figs. 52 and 53). All of the bias rectifier components, except bias rectifier tubes V–201 through V–203 and BIAS switch S–202, are located on a subchassis in the lower left-hand corner of the amplifier unit. To remove the subchassis, disconnect leads to terminals on

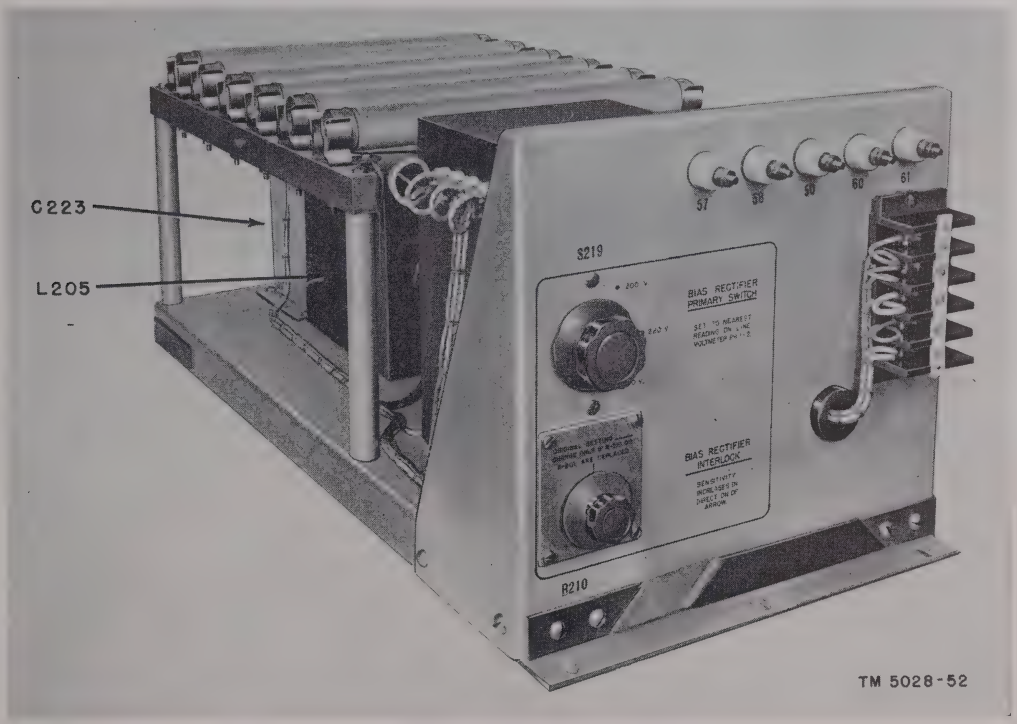


Figure 52. Bias rectifier, front view.

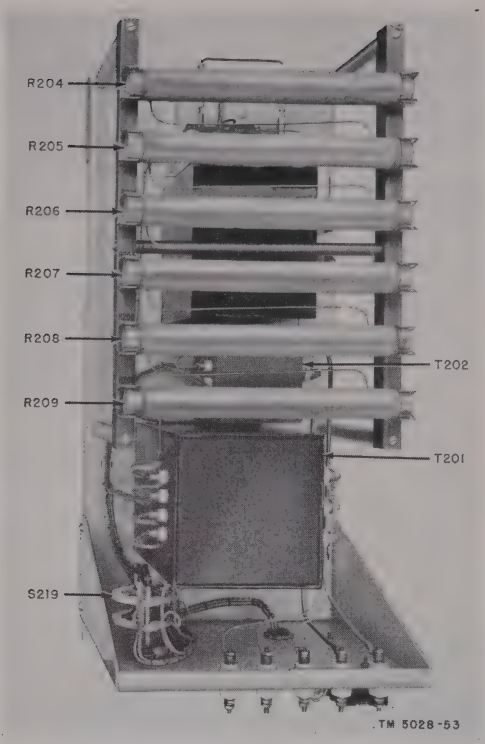


Figure 53. Bias rectifier, top view.

subpanel, take out three screws along the front flange of the subpanel, and slide out the subchassis. Be careful to avoid the door stop. A bakelite strip is mounted across the front of the bottom shelf to prevent scratching. The back flange of the subchassis is held down by fixed cleats on the bottom shelf, so that removal of hardware at the back of the subchassis is unnecessary.

b. Amplifier Control Panels. The control panels on either side of the upper door on the amplifier contain components which cannot be serviced unless the panels are removed. Use the following procedure for either panel:

(1) Remove the side or back panel to expose the variometers connected to the tuning controls. If working on the left-hand control panel (bearing PLATE TUNING control), also remove the access hatch below the PLATE COIL TAPS board inside the upper door.

(2) Set the tuning control to 0 and lock it.

(3) With a pencil mark, index the variometer shaft against its bearing on the back end of the variometer.

(4) Loosen the insulated shaft coupling setscrews on the front end of the variometer shaft.

(5) Supporting the panel, remove the screws which hold the panel to the frame.

(6) Gently pull the panel straight back an inch or two to disengage the shaft coupling. A little wiggling may be necessary. Do not force it because of the possibility of cracking a shaft coupling.

(7) After the shaft coupling is clear, it will be possible to swing the panel out for servicing because slack cables are wired to the other controls. Note that the controls on the left-hand panel are in a shield box which must be removed to expose them.

(8) When reassembling the panel, make sure the index mark made on the variometer in step (3) above is alined before tightening the shaft coupling.

c. Blowers (fig. 54). Blowers B–201 and B–301 and their mounting plates are interchangeable Always remove the blower by its mounting plate. Do not attempt to remove the blower from its mounting plate while the mounting plate is in the equipment.

d. Grid Variometer. Note that the mounting brackets of grid variometer L–201 are wired together and connected to a terminal on the coil. If this coil must be removed, make sure the bracket wiring is replaced.

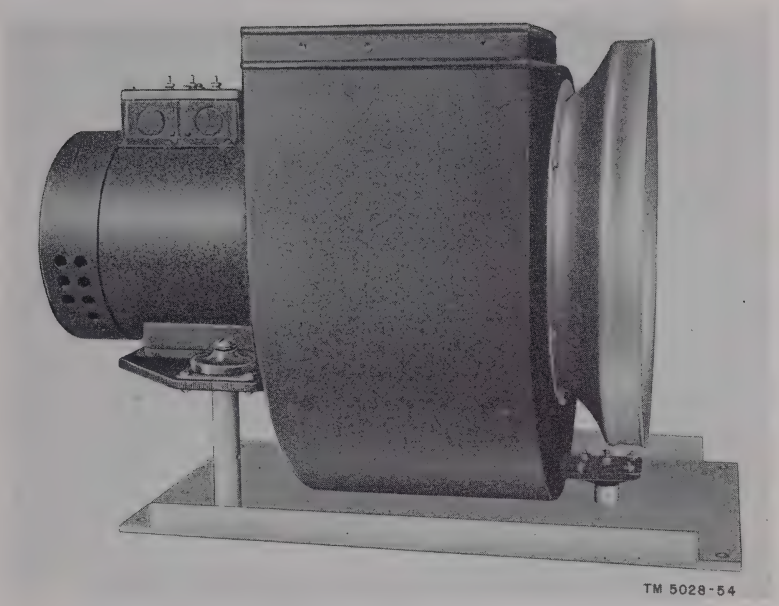


Figure 54. Blower subassembly.

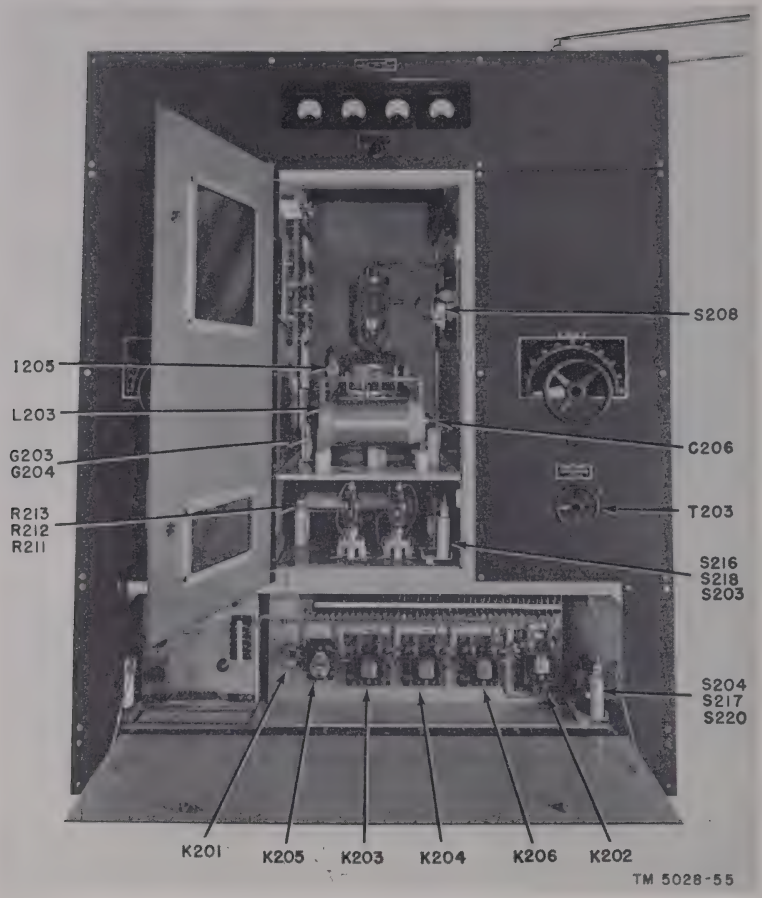


Figure 55. Amplifier, front view.

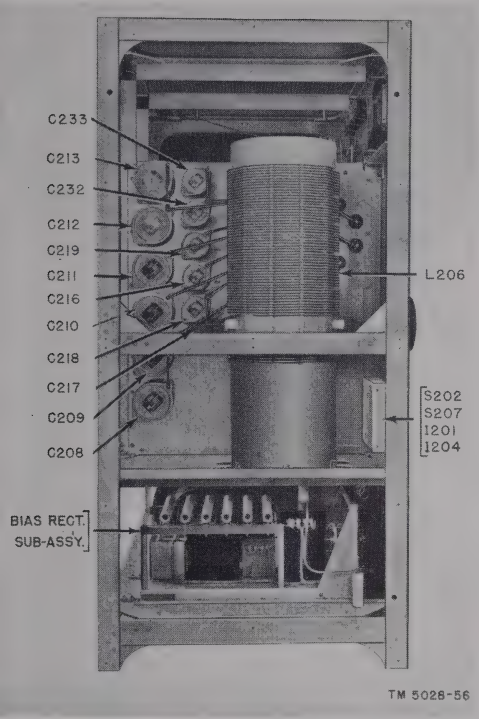


Figure 56. Amplifier, left side view.

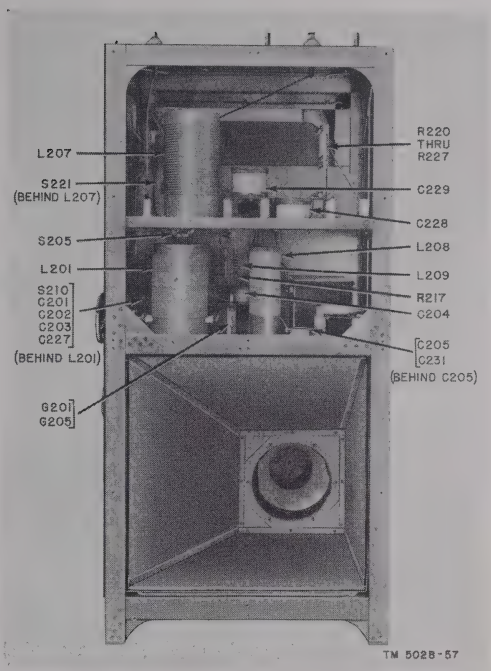


Figure 57. Amplifier, right side view.

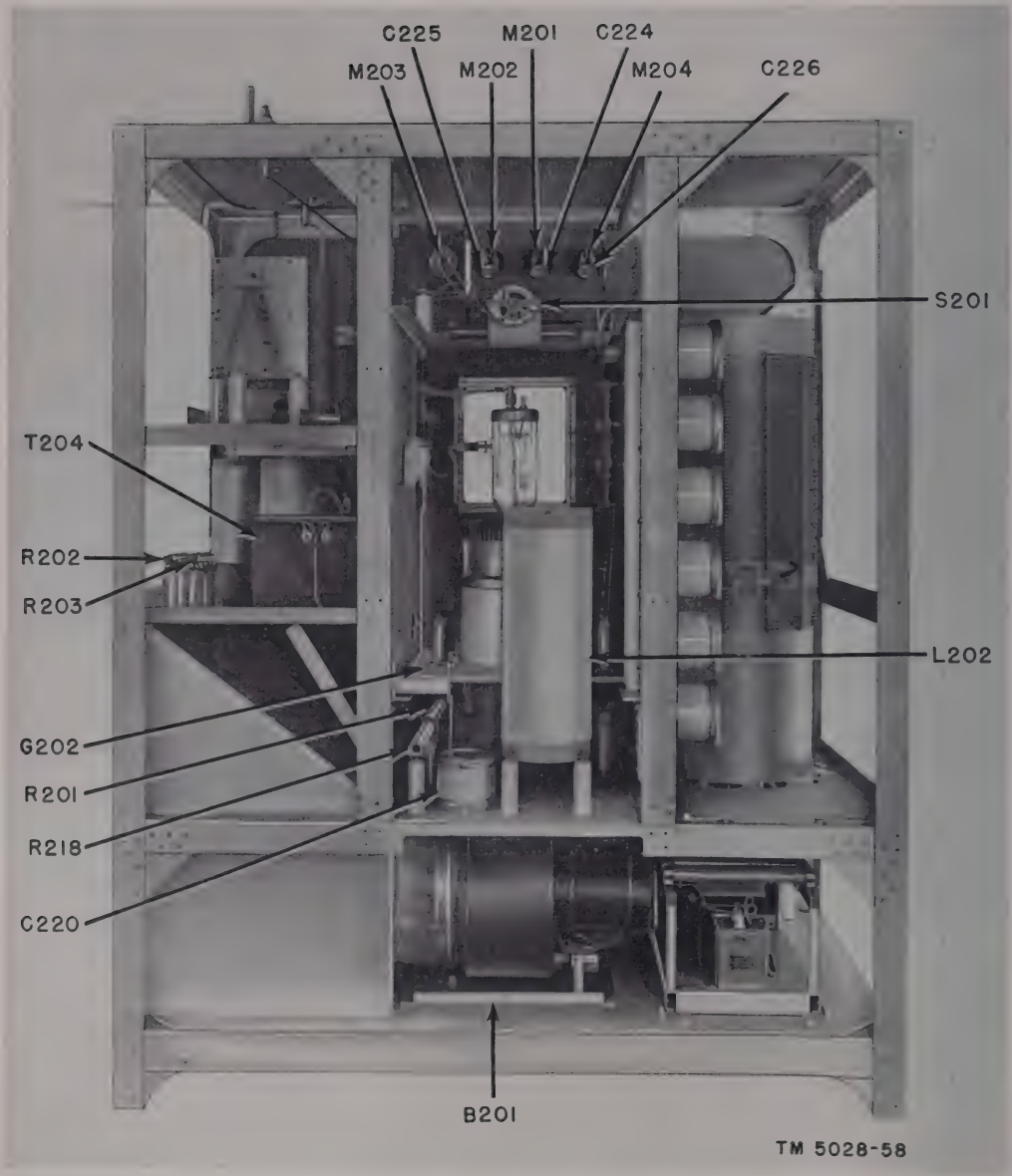


Figure 58. Amplifier, rear view.

Section XIII. TROUBLE LOCATION

Note. Make use of the material in sections IV through XI. Refer to schematic diagrams (figs. 63, 64, and 65), practical wiring diagrams (figs. 66 and 67), parts location photographs (figs. 52 through 62), and appendix III.

43. Preliminary Procedure

a. Safety. (1) Before trouble shooting, stop the equipment, allow the amplifier blower to overrun, then open the transmitter house line switch to the equipment.

(2) Open relay panel doors and look for frozen or jammed relays.

Warning: When making tests with the panels off, remember that there is no interlock protection on these panels and that high voltages are exposed. Use ground hook.

b. Visual Checks. Many times the causes for trouble are simple and obvious. Before trouble shooting, examine the equipment thoroughly for any obvious faults such as the following:

(1) Check tightness of interconnections between major components and also check bus wiring in antenna tuning unit.

(2) Check tubes for cracked glass, loose connections, loose fit in sockets.

(3) Check tuning shaft couplings. A broken ceramic in a shaft coupling may allow a tuning shaft to slip.

(4) Check transmitter house fuses or other protective devices and check power connections.

c. Indicator and Illuminating Lamps. Test indicator and illuminating lamps outside equipment. If a 115-volt supply is not available, check continuity with an ohmmeter.

d. Tubes. Test filaments of tubes in lit and unlit conditions. Sometimes a tube will show filament continuity by ohmmeter check but will light up intermittently, briefly, or not at all, on application of filament voltage.

(1) Open upper doors on amplifier and rectifier and open both doors on exciter.

(2) *Start equipment.* Look for unlit tubes. Some kinds of mercury vapor tubes have hidden filaments. Check these by feeling the tube after a few minutes of operation. The tube should be noticeably warm.

(3) *Stop equipment.* Remove tubes one by one and with an ohmmeter check filament continuity of those which do not light. V–201 (Tube JAN–891R) can be checked on its mounting by disconnecting one filament lead.

(4) With an ohmmeter, check for shorts between filament and other elements.

(5) The object of these tests is to make reasonably sure that a set of tubes with continuous filaments and no shorted elements is in place before further trouble shooting. Other kinds of tube trouble will show up on later tests.

44. Sectionalizing Trouble

Most troubles in this equipment can be tracked down by interpreting meter readings. Personnel who undertake to do this preferably should have tuned the equipment at least once so that they are thoroughly familiar with the control circuit, normal meter readings (table II), and the effect of tuning controls. At least two men are required for safe trouble shooting, one at the antenna tuning unit and one at the transmitter house.

a. Control Circuit. If the equipment fails to start or stop normally, or fails during transmission, the control circuit may be at fault. Other troubles, overloads for example, may prevent the control circuit from functioning normally. To sectionalize the trouble to the control circuit, use the procedure in paragraph 26. This will allow the control circuit to function without energizing transformer primary circuits.

b. Amplifier. Check the amplifier independently of the antenna tuning unit by opening the NEUTRALIZING LINK on the amplifier. Use the procedure of paragraph 28 which constitutes a no-load check.

c. Rectifier. Plate overloads or loss of output may indicate trouble in the rectifier unit. To limit trouble shooting to the rectifier, disconnect the lead from terminal No. 19 (high voltage). Plate voltage, or the lack of it, or overloads caused by defective rectifier components, will then be indicated independently of the rest of the equipment.

d. Antenna Tuning Unit. If ANTENNA CURRENT reads low and R. F. LINE CURRENT reads high, accompanied by high PLATE CURRENT reading, antenna circuits may be detuned. Low PLATE CURRENT reading and zero R. F. LINE CURRENT and ANTENNA CURRENT reading means either fuse F-401 has blown (probably because of severe detuning) or there is an open transmission line. If retuning does not correct the condition, the fault may be in the amplifier.

e. Exciter. Low or zero GRID CURRENT combined with low output indicates exciter trouble. Set GRID FUNCTION SWITCH to TUNE position, set PRI. VOLTAGE ADJ. switch to OFF, and check the exciter independently of the amplifier, using TM 11–828.

f. Gradual Changes in Meter Readings. (1) Gradual changes in daily meter readings which cannot be brought to normal by retuning indicate failing emission in tubes.

(2) Decrease in ANTENNA CURRENT, R. F. LINE CURRENT, PLATE CURRENT, and GRID CURRENT (on exciter or antenna tuning unit), with normal readings elsewhere, indicates a defective tube V–201. If at the same time the exciter ANT. CURRENT and POWER AMP. PLATE meter readings are low, the exciter output tubes probably are failing.

45. Localizing Trouble

After sectionalizing the trouble, refer to the subparagraphs below to trace the trouble to the specific part or parts. Use the multitester to check continuity, shorts, or presence of operating voltage on relay coils and contacts. The cures are implied by the cause: replace defective parts, retune mistuned circuits, repair defective insulation, etc. The symptoms and causes given here are limited to the more probable troubles; technical personnel must rely on their experience and knowledge of the equipment to trace more obscure faults.

a. Control Circuits.

Symptom	Probable cause
Equipment fails to start; K–302 fails to close.	(1) K–301 motor defective. (2) K–302 coil open. (3) Fuse F–1, F–2, or F–3 in exciter blown. (4) Remote control line open.
Filaments and blowers start, but there is no plate voltage; K–305 fails to close.	(1) K–304 motor defective. (2) K–201 fails to close because of defective tube V–203 and/or V–204. (3) Door interlock open. (4) R–210 or R–335 out of equipment. (5) T–201 or T–202 defective.
B–201 fails to stop	K–205 motor defective.
Amplifier plate voltage present, but there is no exciter plate voltage.	RL–5 on exciter defective.
Equipment fails to stop normally.	Check for frozen or jammed relay (except K–302).

a. Control Circuits—Continued

b. Amplifier.

Symptom	Probable cause
Arcing across G–201 and/or G–205.	Improper neutralization (par. 28*b*).
Plate overload relay trips	(1) Plate circuit mistuned. (2) Plate tank or load capacitor shorted or open. (3) C–220 shorted. (4) No fixed bias. (5) S–203 or S–220 defective.
GRID CURRENT low or reversed.	V–201 grid emits; replace.
No GRID CURRENT	(1) Mistuning. (2) Exciter failure. (3) L–201 has shorted or open turn. (4) Grid tank capacitors shorted or open.
GRID CURRENT but no PLATE CURRENT.	L–202 open.
No fixed bias	L–208, R–202, or R–203 open. C–205 shorted.

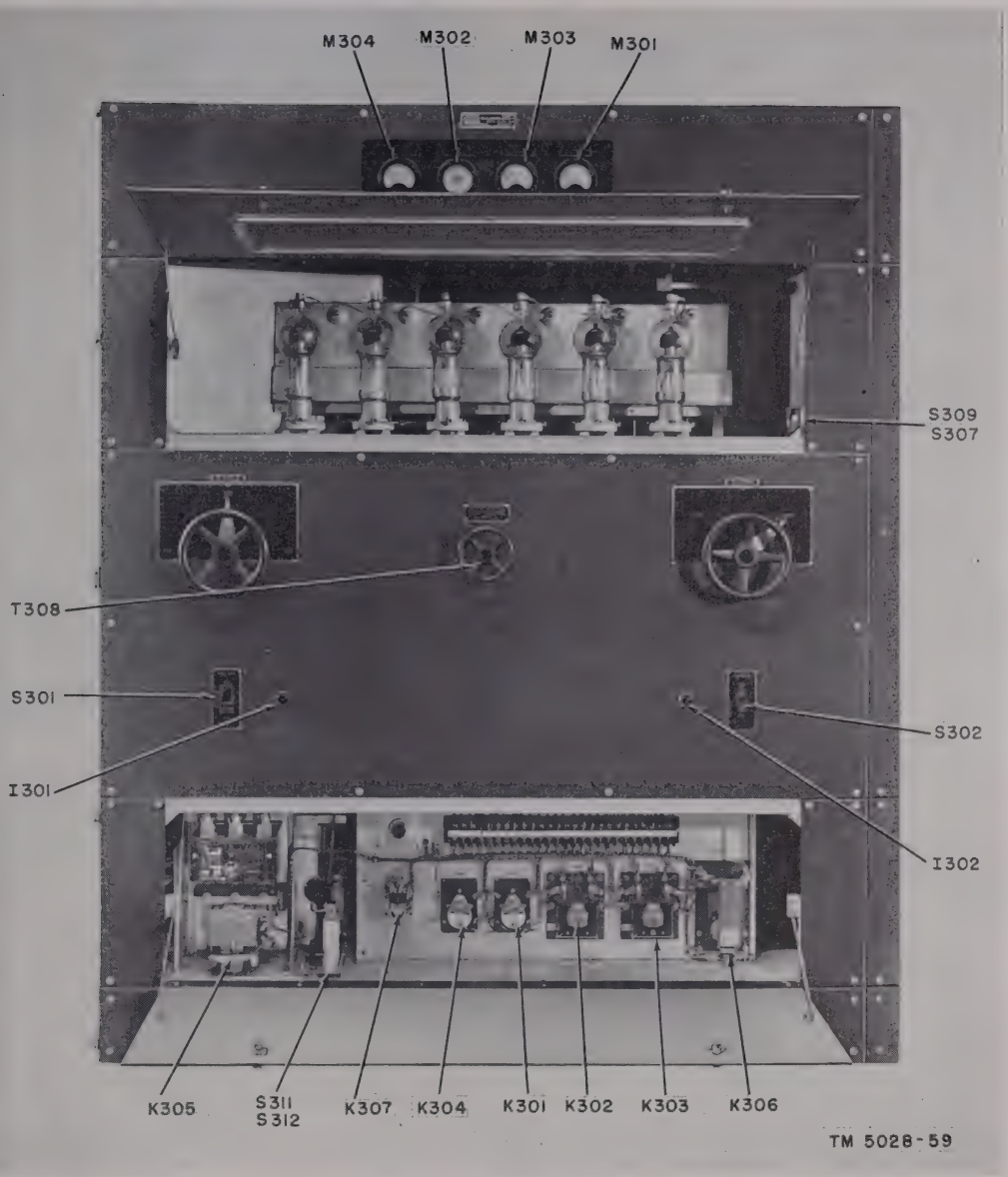


Figure 59. Rectifier, front view.

c. Rectifier.

Symptom	Probable cause
MAIN LINE breaker trips.	(1) Flashbacks in rectifier. (2) C–301 shorted. (3) Filament or plate transformer shorted.
MAIN LINE breaker trips with all rectifier tubes out.	Plate transformer shorted; test one at a time.
Rectifier tubes fail frequently.	Room too cold (par. 31*a*).
Flashbacks in rectifier tubes.	Room too hot (par. 31*b*).

46. Apparatus Adjustment

a. Plate Overload Relay. Plate overload relay K–307 is actuated by the voltage drop across potentiometer R–335. The pull-in or trip point is set by means of the potentiometer. If either R–335 or K–307 is replaced, set R–335 so that K–307 trips at 1.8 amperes on the PLATE CURRENT meter. This can be done by detuning the PLATE TUNING control slightly.

b. Bias Rectifier Interlock Relay. Bias rectifier interlock relay K–201 is actuated by the voltage drop across potentiometer R–210. The pull-in point is set by means of the potentiometer. If either R–210 or K–201 is replaced, set R–210 so that K–307 is closed with both V–202 and V–203 operating but open with only V–202 or only V–203 operating.

Warning: Set PRI. VOLTAGE ADJ. switch to OFF when making this adjustment.

47. Repairs

Repair of this equipment is limited practically to replacement of defective or broken components.

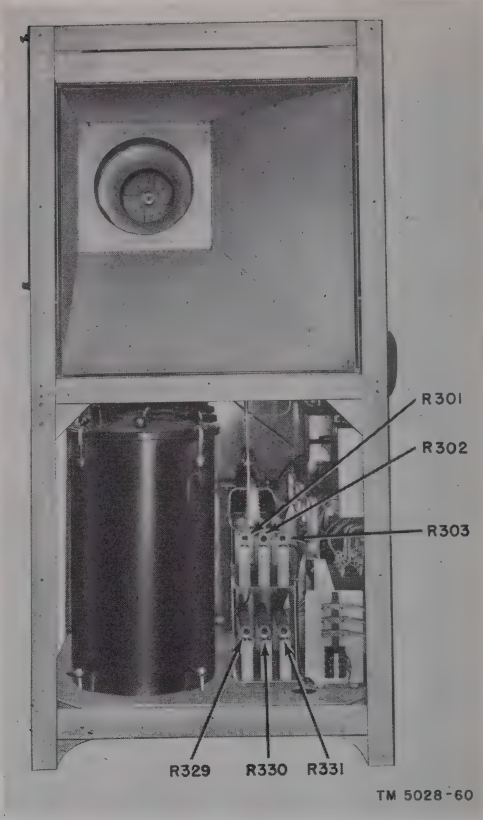


Figure 60. Rectifier, left side view.

Damage to the windings of r-f coils can be repaired if the proper wire and skill are available. Cracked ceramic winding bars on large r-f coils need not be replaced because the windings and impregnation usually hold them in place.

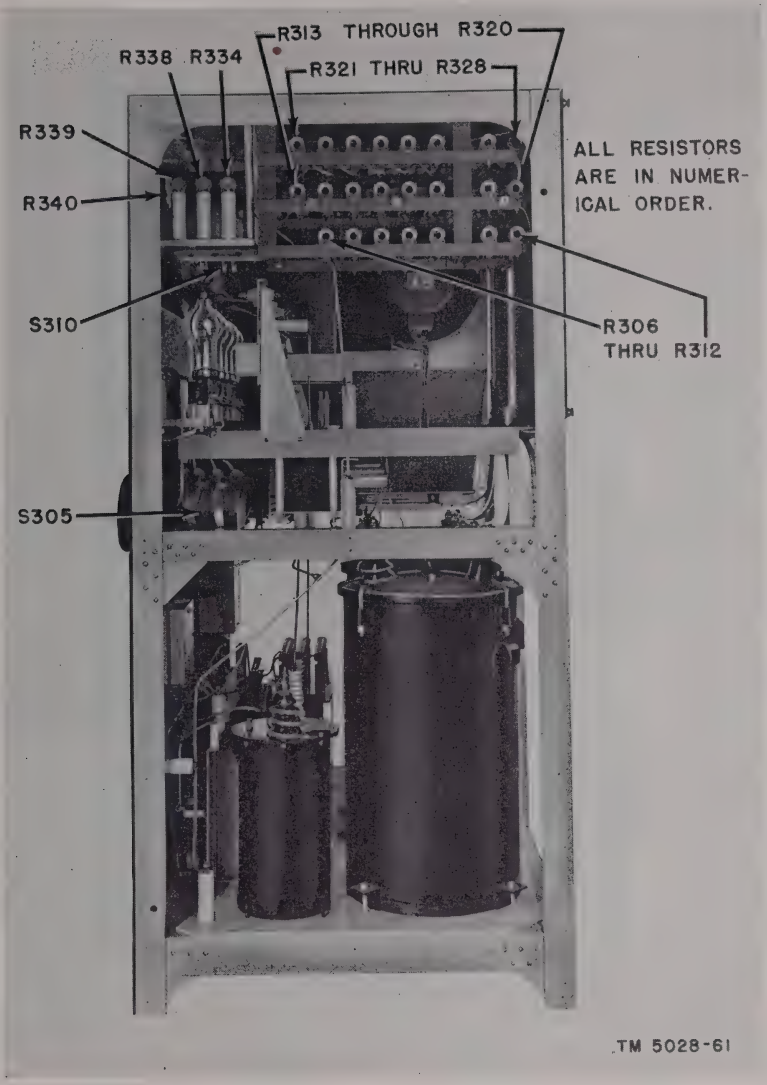


Figure 61. Rectifier, right side view.

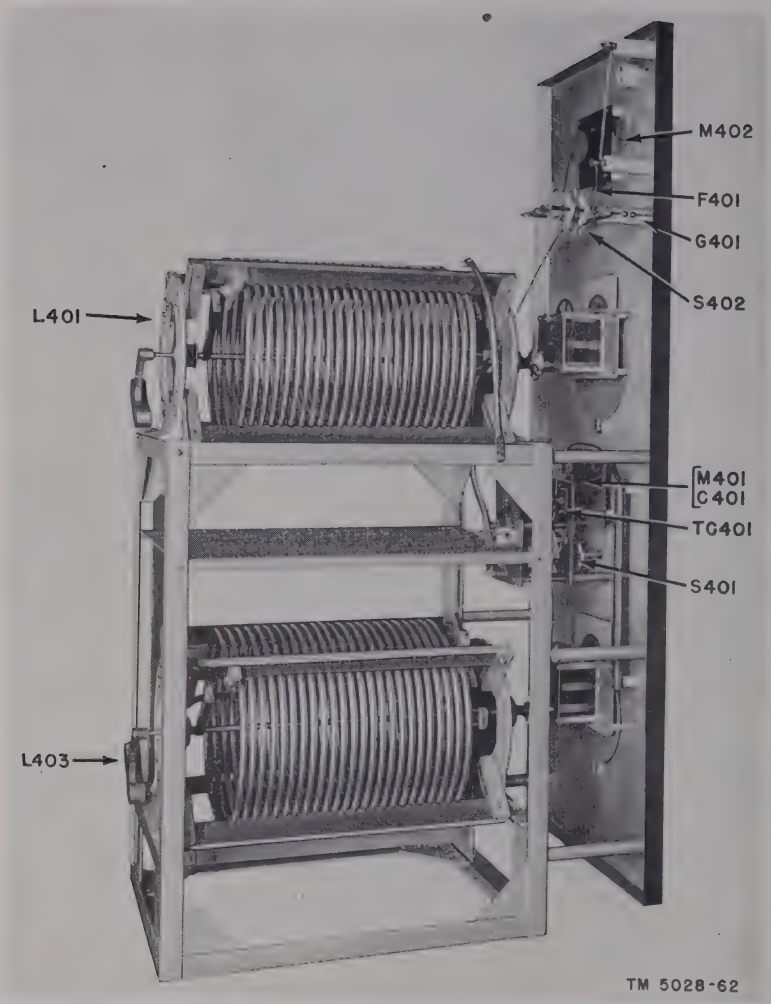


Figure 62. Main subassembly for antenna tuning unit, left side view.

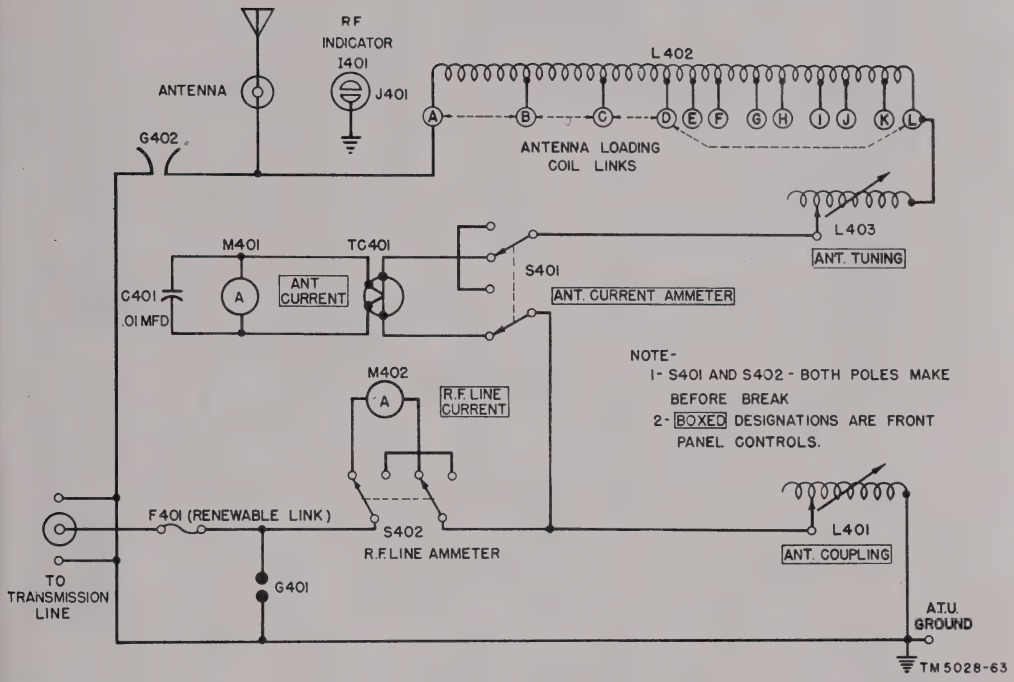
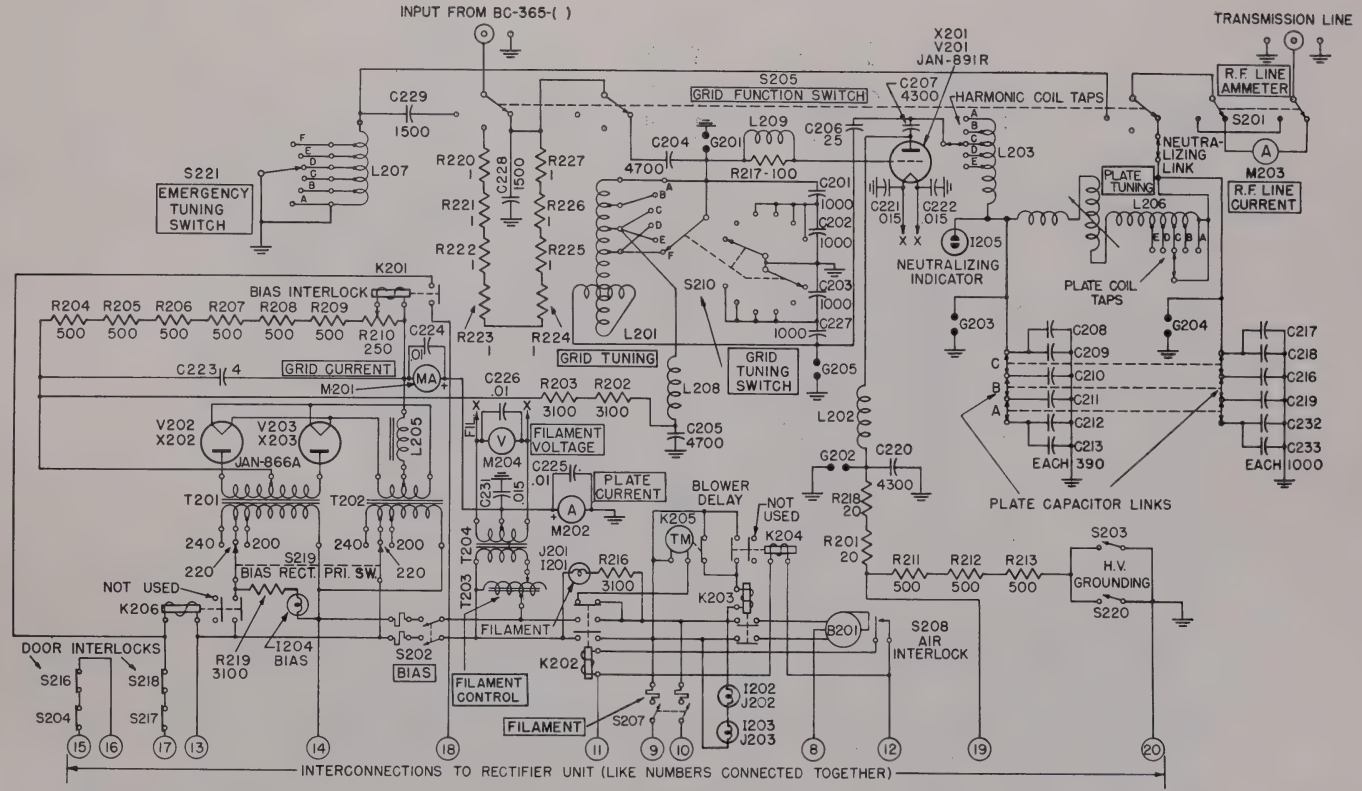


Figure 63. Antenna tuning unit, schematic diagram.



NOTES:- (TM) = TIMER MOTOR
ALL RELAYS SHOWN UNENERGIZED
S201-BOTH POLES MAKE BEFORE BREAK
BOXED DESIGNATIONS ARE FRONT PANEL CONTROLS
RESISTORS IN OHMS, CAPACITORS IN MICROMICROFARADS OR MICROFARADS. K=1000

EXAMPLE: C205-4700 MICROMICROFARADS; C231-0.015 MICROFARADS

TM5028-64

Figure 64. Amplifier, schematic diagram.

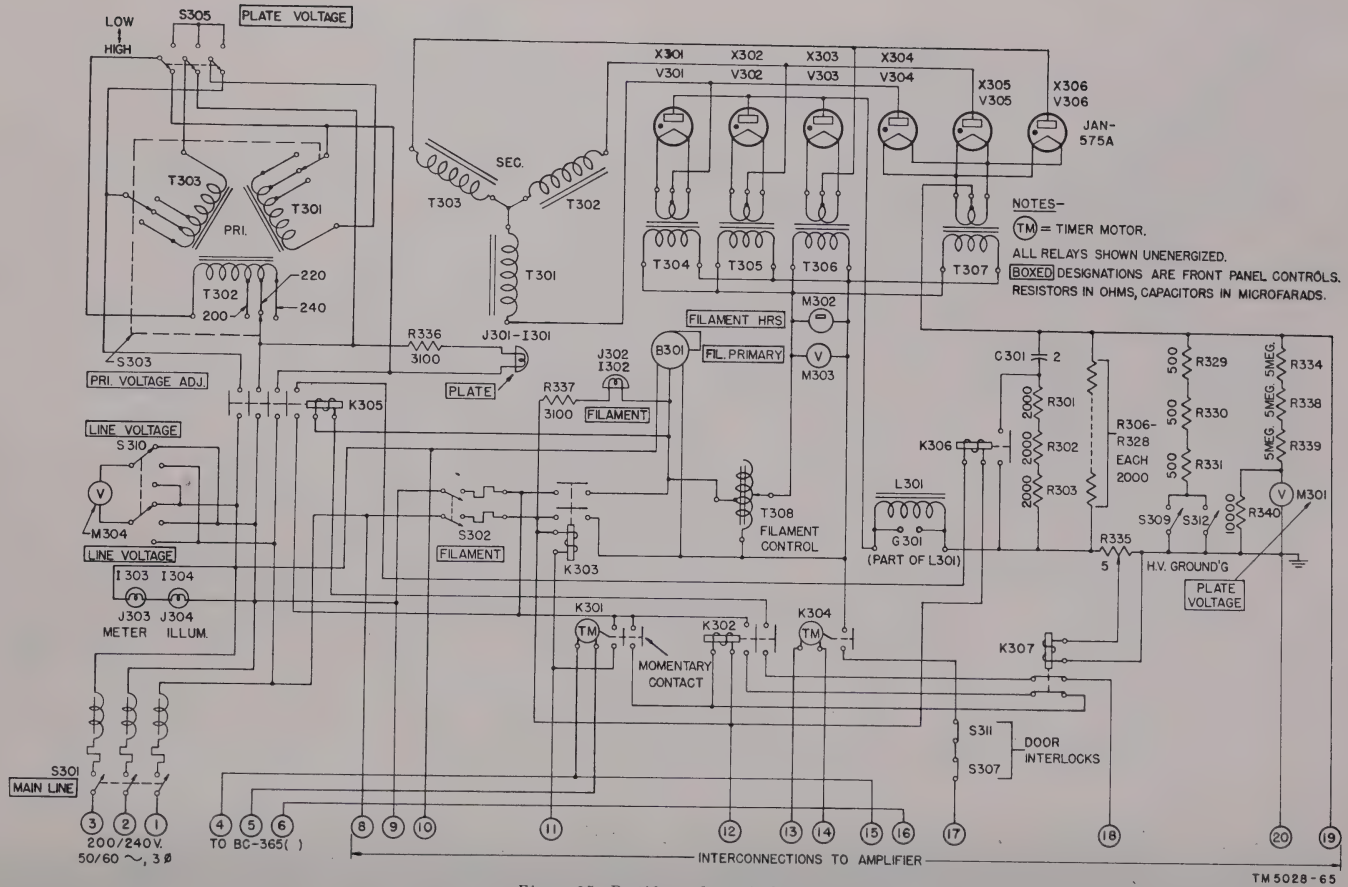
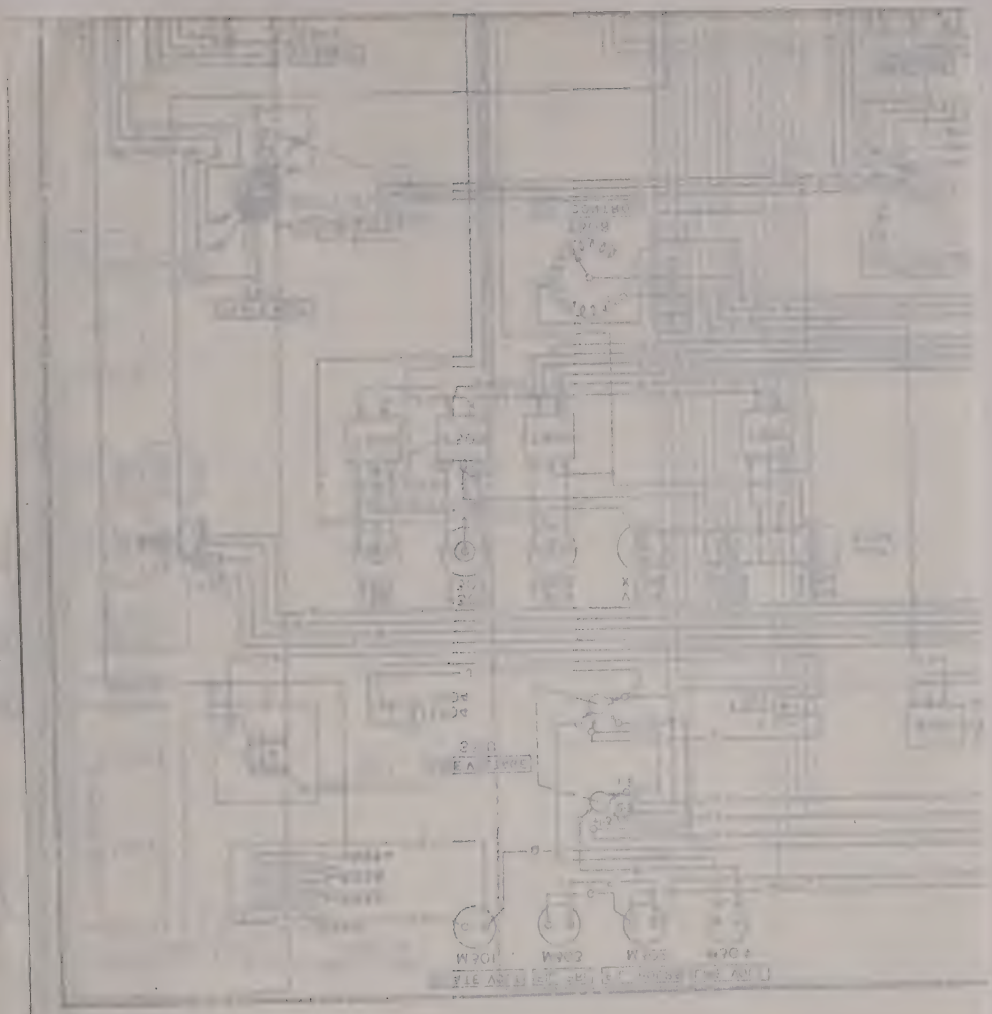
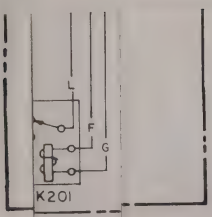


Figure 65. Rectifier, schematic diagram.





TM5028-66

gure 66. A

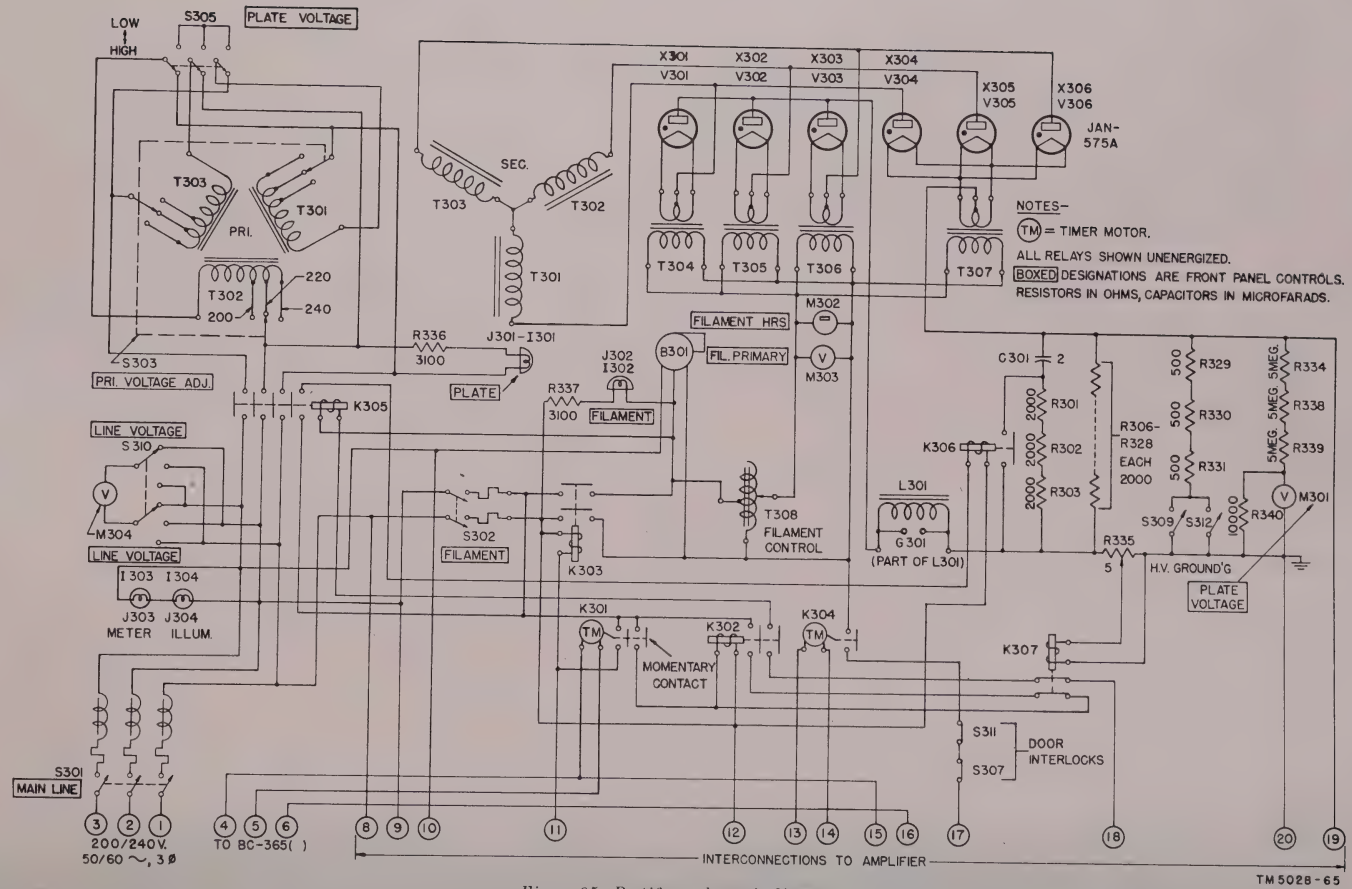


Figure 65. Rectifier, schematic diagram.

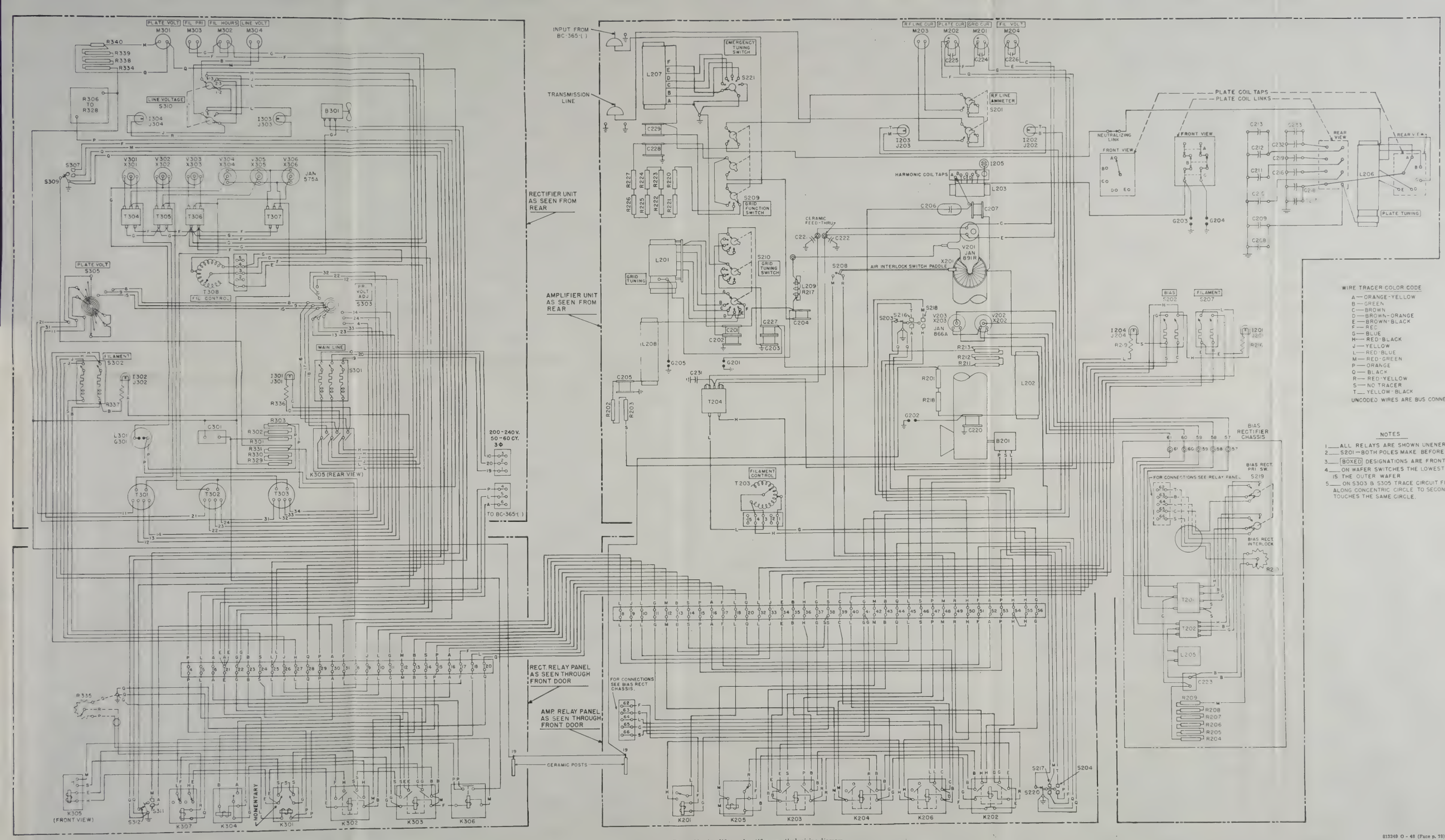


Figure 66. Amplifier and rectifier, practical wiring diagram.

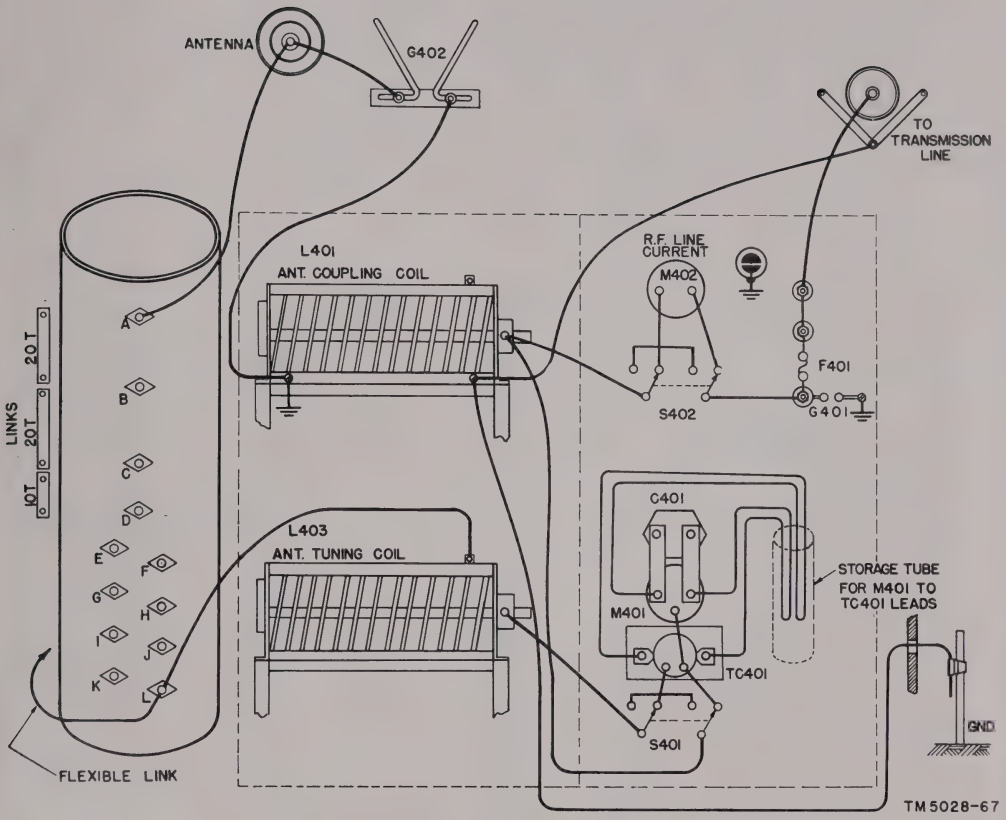


Figure 67. Antenna tuning unit, practical wiring diagram.

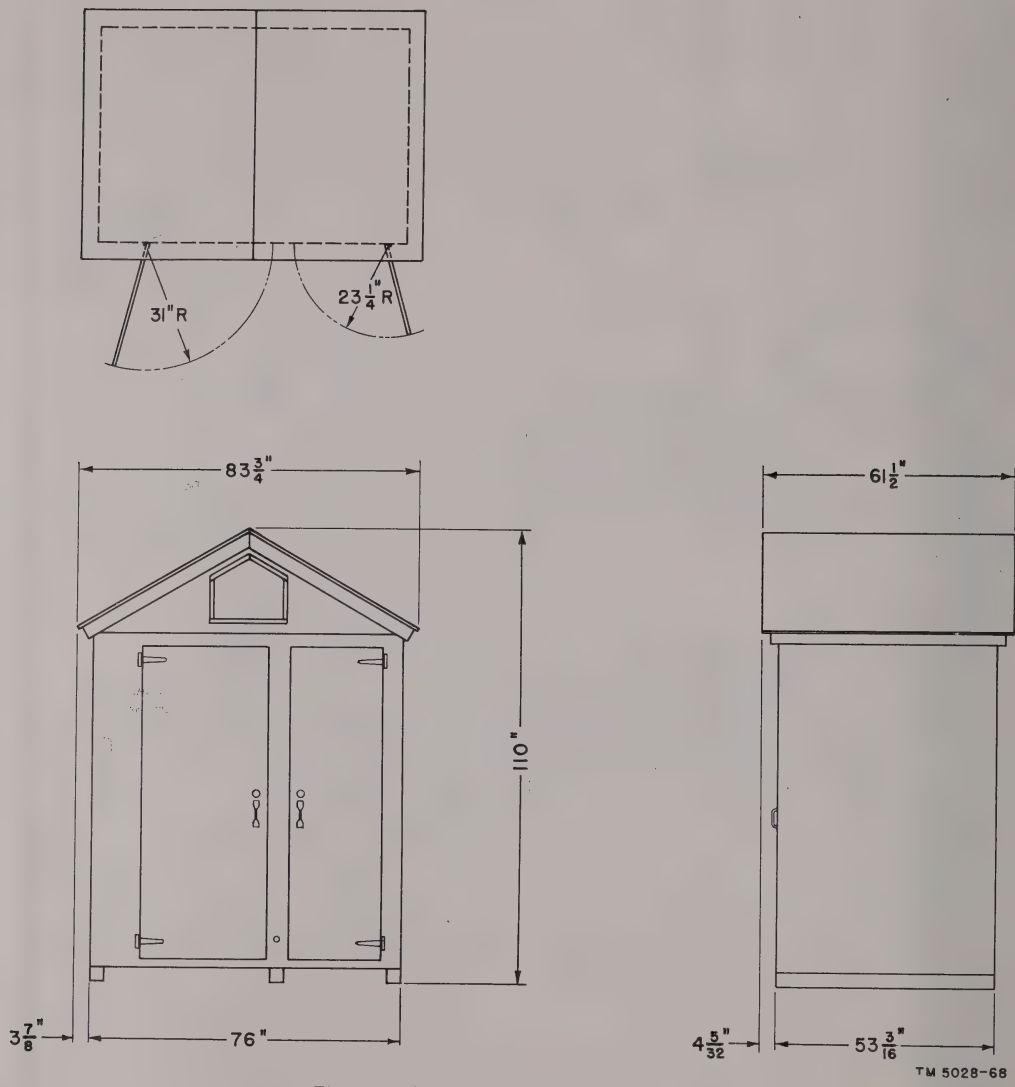
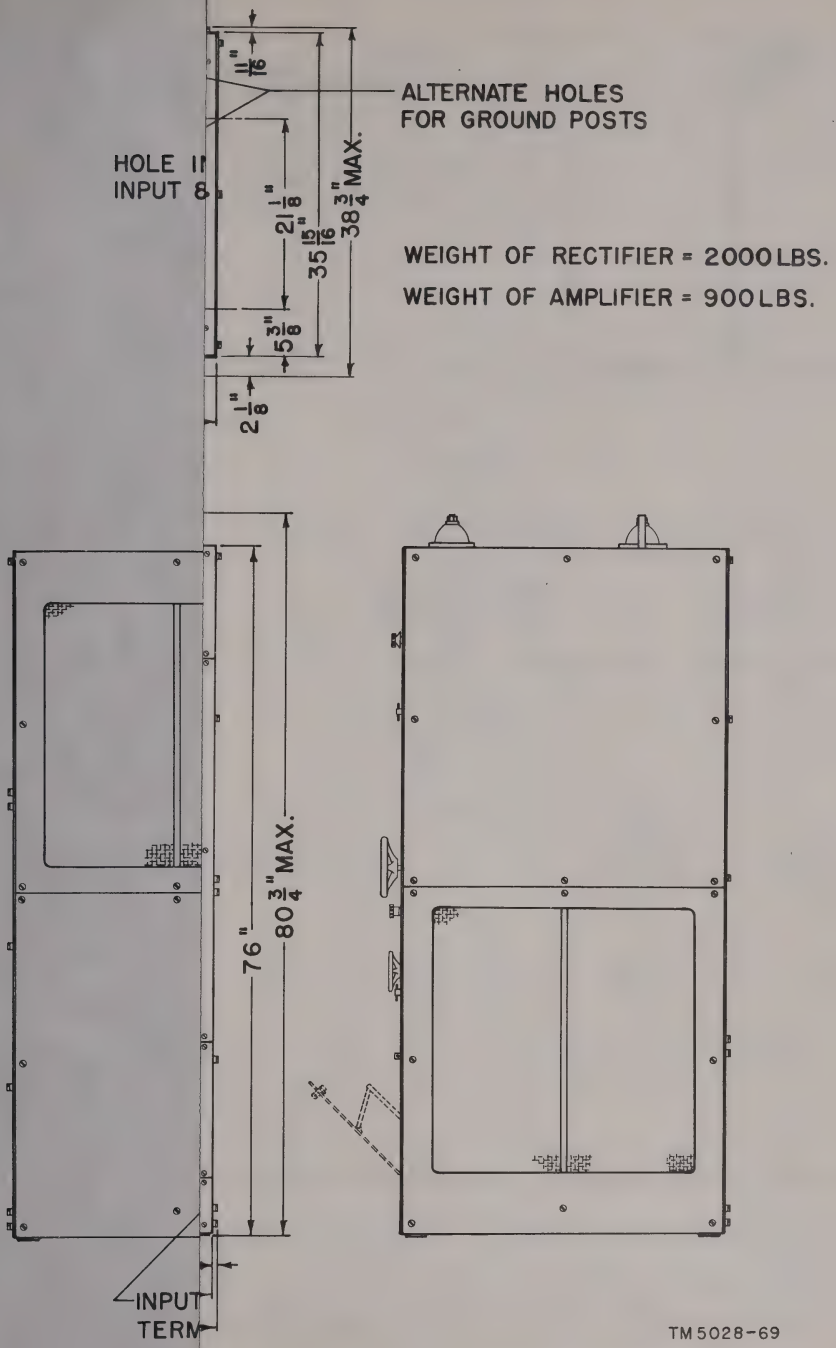


Figure 68. Antenna tuning unit, outline drawing.


ALTERNATE HOLES
FOR GROUND POSTS
HOLE I
INPUT &
WEIGHT OF RECTIFIER = 2000 LBS.
WEIGHT OF AMPLIFIER = 900 LBS.
11/16"
21 1/8"
35 15/16"
38 3/4" MAX.
5 3/8"
2 1/8"
76"
80 3/4" MAX.
INPUT
TERM
TM 5028-69

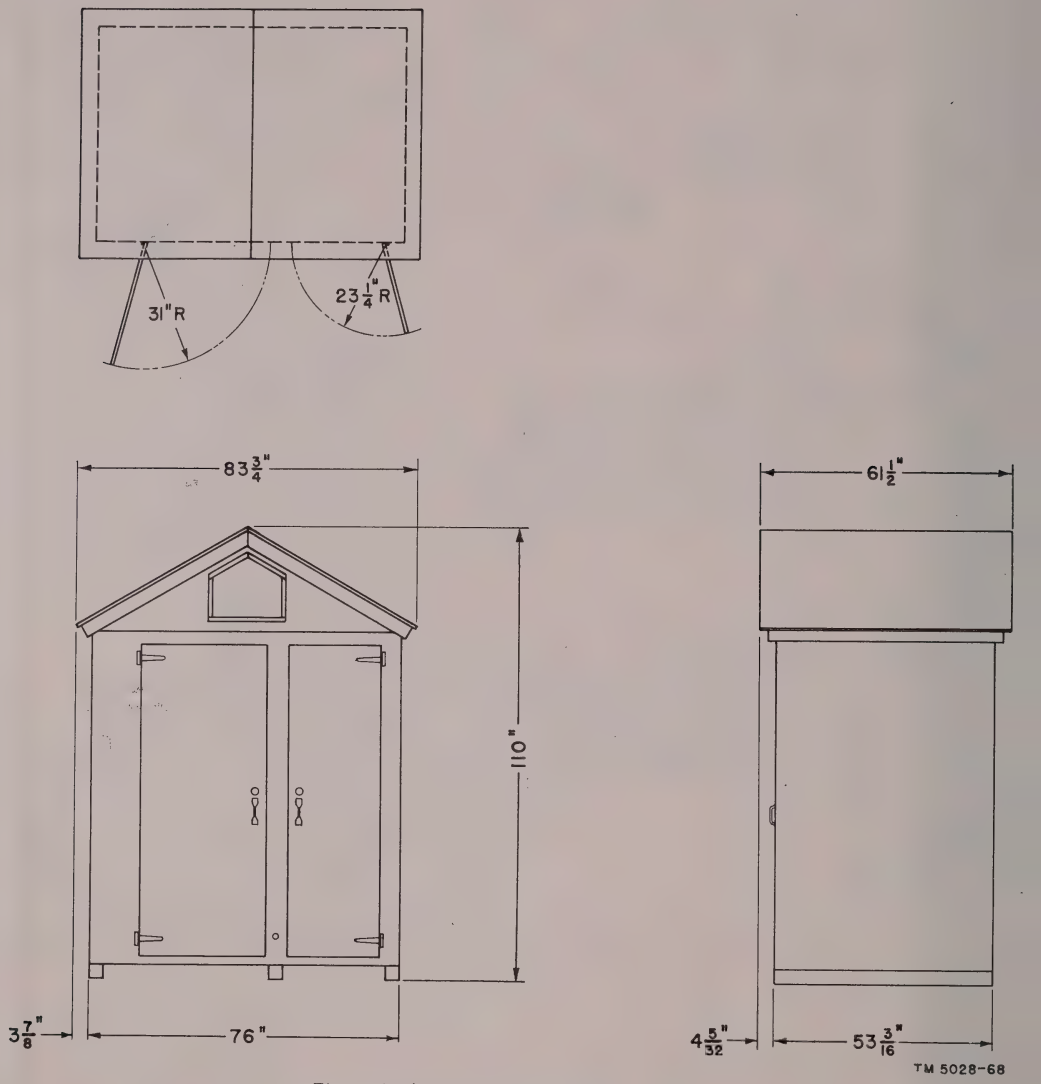


Figure 68. Antenna tuning unit, outline drawing.

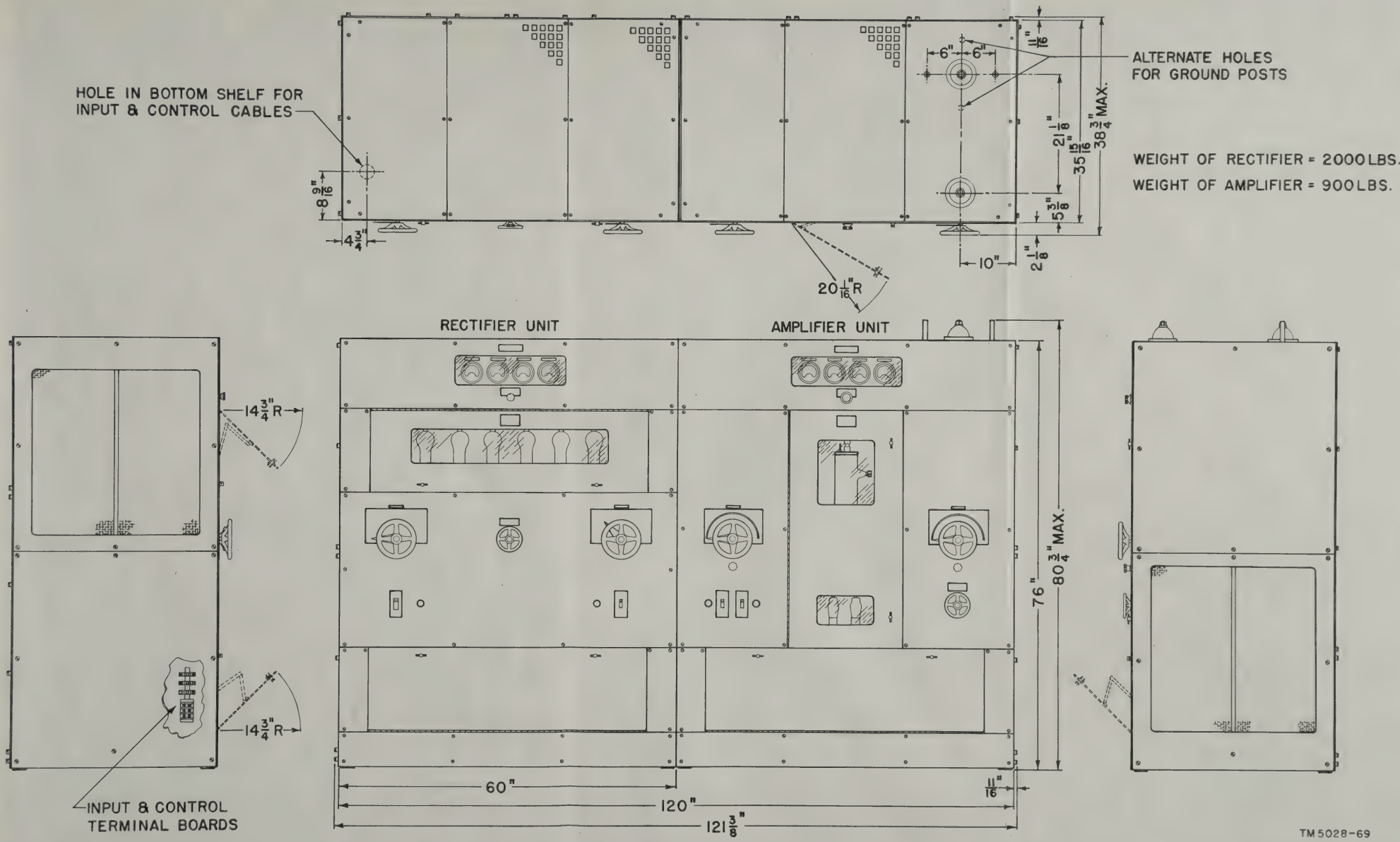
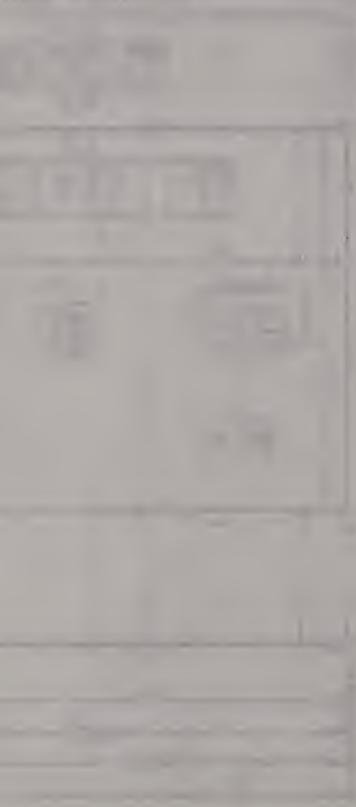
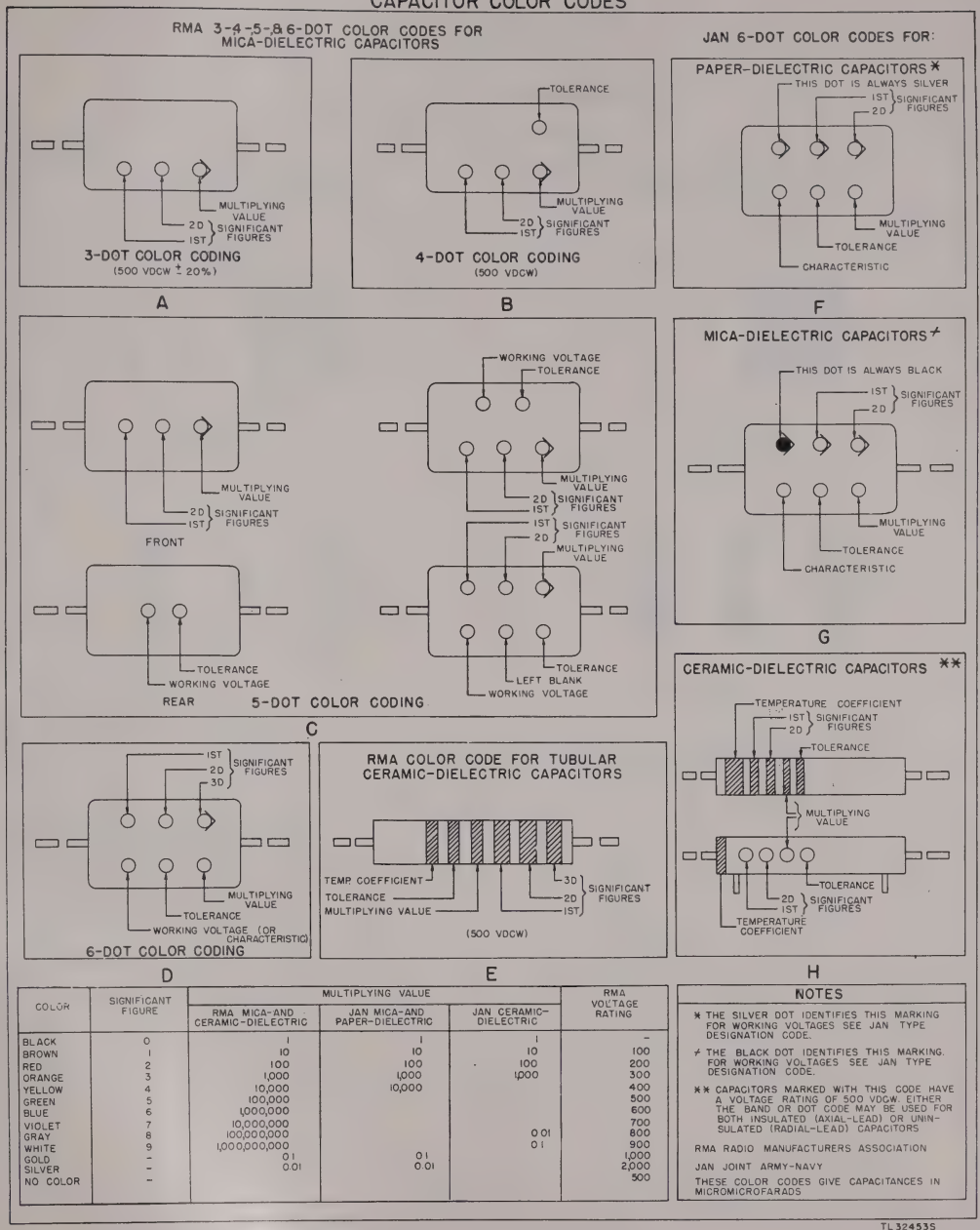

HOLE IN BOTTOM SHELF FOR INPUT & CONTROL CABLES
ALTERNATE HOLES FOR GROUND POSTS
WEIGHT OF RECTIFIER = 2000 LBS.
WEIGHT OF AMPLIFIER = 900 LBS.
RECTIFIER UNIT
AMPLIFIER UNIT
INPUT & CONTROL TERMINAL BOARDS
TM 5028-69

Figure 69. Amplifier and rectifier, outline drawing.





COLOR	SIGNIFICANT FIGURE	MULTIPLYING VALUE			RMA VOLTAGE RATING
		RMA MICA-AND CERAMIC-DIELECTRIC	JAN MICA-AND PAPER-DIELECTRIC	JAN CERAMIC-DIELECTRIC	
BLACK	0	1	1	1	-
BROWN	1	10	10	10	100
RED	2	100	100	100	200
ORANGE	3	1,000	1,000	1,000	300
YELLOW	4	10,000	10,000		400
GREEN	5	100,000			500
BLUE	6	1,000,000			600
VIOLET	7	10,000,000			700
GRAY	8	100,000,000		0.01	800
WHITE	9	1,000,000,000		0.1	900
GOLD	-	0.1	0.1		1,000
SILVER	-	0.01	0.01		2,000
NO COLOR	-				500

NOTES

* THE SILVER DOT IDENTIFIES THIS MARKING FOR WORKING VOLTAGES SEE JAN TYPE DESIGNATION CODE.

† THE BLACK DOT IDENTIFIES THIS MARKING. FOR WORKING VOLTAGES SEE JAN TYPE DESIGNATION CODE.

** CAPACITORS MARKED WITH THIS CODE HAVE A VOLTAGE RATING OF 500 VDCW. EITHER THE BAND OR DOT CODE MAY BE USED FOR BOTH INSULATED (AXIAL-LEAD) OR UNINSULATED (RADIAL-LEAD) CAPACITORS

RMA RADIO MANUFACTURERS ASSOCIATION

JAN JOINT ARMY-NAVY

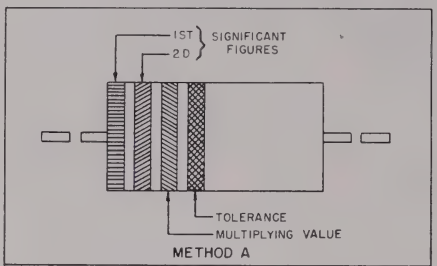
THESE COLOR CODES GIVE CAPACITANCES IN MICROMICROFARADS

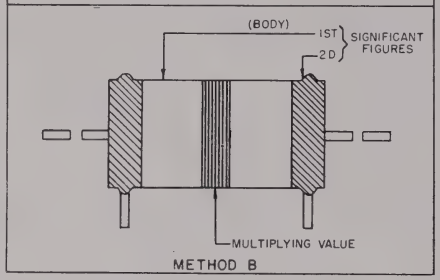
TL 32453S

Figure 70. Capacitor color codes.

RESISTOR COLOR CODES

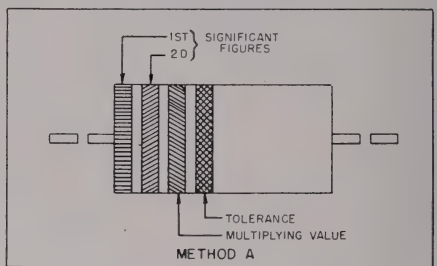
RMA COLOR CODE FOR FIXED COMPOSITION RESISTORS*

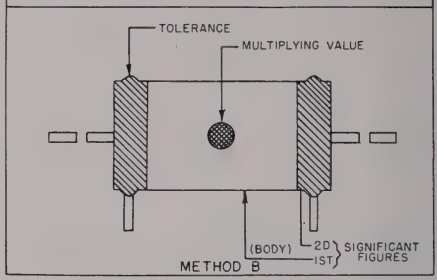




A

JAN COLOR CODE FOR FIXED COMPOSITION RESISTORS/





B

COLOR	SIGNIFICANT FIGURE	MULTIPLYING VALUE	TOLERANCE (%)
BLACK	0	1	± –
BROWN	1	10	± 1
RED	2	100	± 2
ORANGE	3	1,000	± 3
YELLOW	4	10,000	± 4
GREEN	5	100,000	± 5
BLUE	6	1,000,000	± 6
VIOLET	7	10,000,000	± 7
GRAY	8	100,000,000	± 8
WHITE	9	1,000,000,000	± 9
GOLD	–	0.1	± 5
SILVER	–	0.01	± 10
NO COLOR	–	–	± 20

NOTES

* INSULATED FIXED COMPOSITION RESISTORS WITH AXIAL LEADS ARE DESIGNATED BY A NATURAL TAN BACKGROUND COLOR. NON-INSULATED FIXED COMPOSITION RESISTORS WITH AXIAL LEADS ARE DESIGNATED BY A BLACK BACKGROUND.

/ RESISTORS WITH AXIAL LEADS ARE INSULATED. RESISTORS WITH RADIAL LEADS ARE NON-INSULATED.

RMA: RADIO MANUFACTURERS ASSOCIATION

JAN: JOINT army-navy

THESE COLOR CODES GIVE ALL RESISTANCE VALUES IN OHMS.

TL 32454S

Figure 71. Resistor color codes.

APPENDIX I
SHIPMENT AND STORAGE

1. Disassembly

If disassembly of Amplifier Assembly AN/FRA–1A is necessary, study the installation instructions in section III and apply them in reverse so far as practicable. Disassemble the equipment and prepare it for packing in units similar to those in the original packing cases.

2. Repacking

When repacking this equipment, use the original packaging materials when they are available. Simulate the original packing as described in sections II and III.

APPENDIX II
REFERENCES

Note. For availability of items listed, check FM 21–6 and Department of the Army Supply Catalog SIG 1. See FM 21–6 also for applicable technical bulletins, supply bulletins, modification work orders, and changes.

1. Army Regulations

AR 380–5, Safeguarding Military Information.

2. Supply Publications

SIG 1, Introduction and Index.
SIG 10, Fixed Plant Maintenance Lists.
SB 11–17, Electron Tube Supply and Reference Data.
SB 11–76, Signal Corps Kit and Materials for Moisture- and Fungi-Resistant Treatment.

3. Technical Manuals on Auxiliary Equipment and Test Equipment

TM 11–472, Repair and Calibration of Electrical Measuring Equipments.
TM 11–828, Radio Transmitter BC–365–F and Remote Control Unit RM–10–F.
TM 11–2532, Test Set I–153–A (Analyzer, Precision Model 856P).
TM 11–5010, Antenna Kit MX–765/FR.
TM 11–5012, Antenna Tower AB–127/FR.

4. Painting and Preserving

TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment.
TB SIG 66, Winter Maintenance of Signal Equipment.
TB SIG 72, Tropical Maintenance of Ground Signal Equipment.
TB SIG 75, Desert Maintenance of Ground Signal Equipment.
TB SIG 123, Preventive Maintenance Practices for Ground Signal Equipment.
TB SIG 178, Preventive Maintenance Guide for Radio Communication Equipment.

5. Packaging and Packing Instructions

a. Joint Army-Navy Packaging Specifications.
JAN–D–169, Desiccants, Activated.
JAN–P–100, General Specifications.
JAN–P–106, Boxes, Wood, Nailed.
JAN–P–116, Preservation, Methods of.
JAN–P–125, Barrier Material, Waterproof.
JAN–P–131, Barrier Material, Moisture-Vaporproof, Flexible.

b. U. S. Army Specification.
100–2E, Marking Shipments by Contractors (and Signal Corps Supplement thereto).

c. Signal Corps Instructions.
720–7, Standard Pack.
726–15, Interior Marking.

6. Other Publications

FM 21–6, List and Index of Department of the Army Publications.
TM 11–477, Fixed Station Radio Repair and Maintenance (Personnel Training Text).
TM 11–1055, 6–KW R-f Amplifier PA–1A, Rectifier RA–1A, and Antenna Tuning Unit AT–1A.
TM 38–650, Basic Maintenance Manual.

7. Forms

WD AGO Form 468, Unsatisfactory Equipment Report.
AF Form 54, Unsatisfactory Report.

8. Abbreviations

a-c	alternating-current
amp	ampere(s)
C	centigrade
cps	cycles per second
F	Fahrenheit
ID	inside diameter
kc	kilocycle(s)
kva	kilovolt-ampere(s)
kw	kilowatt(s)
ma	milliampere(s)
mmf	micromicrofarad(s)
r-f	radio-frequency

APPENDIX III
IDENTIFICATION TABLE OF REPLACEABLE PARTS

1. General

The fact that a part is listed in this table is not sufficient basis for requisitioning the item. Requisitions must cite an authorized basis, such as T/O&E, TE, TA, T/BA, SIG 6, SIG 7&8, SIG 7–8–10, SIG 10, list of allowances of expendable material, or another authorized supply basis. For an index of available supply catalogs in the Signal portion of the Department of the Army Supply Catalog, see the latest issue of SIG 1.

2. Identification Table of Replaceable Parts for Amplifier Assembly AN/FRA–1A

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
	AMPLIFIER ASSEMBLY AN/FRA–A1: 150 kc to 550 kc; power output 6 kw; power amplifier 76″ h x 60″ wd x 36″ d; rectifier 76″ h x 60″ wd x 36″ d; antenna tuning unit 109″ h x 96¼″ wd x 66½″ d; power imput 220/240 v AC, 50/60 cyc, 3 ph, 60 amp; incl RF transmission line kit, interconnecting cables, 2 cys TM 11–5028, and 3 sets tubes; amplifier and rectifier mtd in metal cabinets; antenna tuning unit in knock-down plywood structure; for use w/Transmitter BC–365–( ) as exciter; Rad Receptor dwgs #C–431–1–B, C–431–301–B, and C–431–601–A.	Radio-frequency power amplifier.	2C466
	TECHNICAL MANUAL: TM 11–5028	Describes equipment	(Order thru AGO channels).
	AMPLIFIER GROUP		
B–201	BLOWER: centrifugal vane; electric motor operated; 36 blades, $7^{29}/_{32}$″ diam; 13⅜″ h x 14⅝″ wd x 17⅞″ d; 1200 cfm displacement at 1725 rpm, 1000 cfm displacement at 1435 rpm; black wrinkle steel housing; Rotron model A, type B–703, dwg #S47090.	General ventilation	6Z995
C–206	CAPACITOR, fixed: vacuum; 25 mmf ±4%; 32.000 vdcw; 2¼″ diam x 6½″ lg sealed glass case; 2 ferrule term $^{13}/_{16}$″ diam x $^{11}/_{16}$″ lg; Eimac type #VC–25–32.	V–201 neutralizing	3D9025–57
C–208 thru C–213	CAPACITOR, fixed: mica; 390 mmf ±5%; 30,000 v peak; 5¾″ h x 5″ diam; potted ceramic case, metal end plates.	V–201 plate tuning	3K9039132
C–201 thru C–203, C–207	CAPACITOR, fixed: mica; 1000 mmf ±5%; 6000 v peak; 2½″ h x $2^{13}/_{16}$″ diam; potted, ceramic case, metal end plates.	V–201 grid tuning	3K7510232
C–216 thru C–219, C–232, C–233	CAPACITOR, fixed: mica; 1000 mmf ±5%; 10,000 v peak; 3″ h x 3½″ diam; potted, ceramic case, metal end plates.	V–201 plate loading	3K8010232
C–228, C–229	CAPACITOR, fixed: mica; 1500 mmf ±5%; 15,000 v peak; 4″ h x 5″ diam; potted, ceramic case, metal end plates.	C–228—V–201 grid tuning C–229—emergency tuning.	3K8515232
C–207, C–220	CAPACITOR, fixed: mica; 4300 mmf ±5%; 12,000 v peak; 4″ h x 5″ diam; potted, ceramic case, metal end plates.	C–207—V–201 plate blocking C–220—V–201 plate return bypass.	3K8543222

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
	AMPLIFIER GROUP—Continued		
C–204, C–205	CAPACITOR, fixed: mica; 4700 mmf ±5%; 6000 v peak; $3^{13}/_{16}$'' lg x $2^{13}/_{16}$'' wd x 2½'' h; potted ceramic case.	C–204—V–201 grid blocking. C–205—V–201 grid return bypass.	3K7547222
C–224 thru C–226	CAPACITOR, fixed: mica; 10,000 mmf ±10%; 1200 vdcw; $1^{25}/_{32}$'' lg x $1^{11}/_{32}$'' wd x $1^{5}/_{32}$'' h; molded case; JAN type CM 55B103K.	C–224—M–201, GRID CURRENT meter, bypass. C–225—M–202, PLATE CURRENT meter, bypass. C–226—M–204, FILAMENT VOLTAGE meter, bypass.	3K5510321
C–221, C–222, C–231	CAPACITOR, fixed: mica; 15,000 mmf±10%; 2500 vdcw; $1^{25}/_{32}$'' lg x $1^{11}/_{32}$'' wd x ¾'' thk; molded case; JAN type CM60B153K.	C–221, C–222—V–201 filament bypass. C–231—V–201 filament center-tap bypass.	3K6015321
C–223	CAPACITOR, fixed: paper dielectric; JAN type CP70E1DL405K; 4 mf±10%; 3000 vdcw; HS metal case; 4¾'' h x $4^{3}/_{16}$'' wd x 3¾'' d.	V–201 grid bias filter	3DB4–272
S–202	CIRCUIT BREAKER: thermal; 2 pole; 125/250 v AC/DC, 15 amp; phenolic case; 6'' lg x 3'' wd x $3^{31}/_{32}$'' h; time delay action, 20 to 30 sec for 200% overload; manual reset; I–T–E type #ET–1230, rear connection.	BIAS switch	3H900–15–41
S–207	CIRCUIT BREAKER: thermal; 2 pole; 125/250 v AC/DC, 20 amp; phenolic case; 6 lg ''x 3'' wd x $3^{31}/_{32}$'' h; time delay action, 20 to 30 sec for 200% overload; manual reset; I–T–E type #ET–1232, front connection.	FILAMENT switch	3H900–20–22
	CLEANER, air: panel type; steel contr; $30^{3}/_{8}$'' lg x $30^{3}/_{8}$'' wd x ¾'' thk; Air-Maze type #R–82S, galv.	Air cleaner.	
	CLIP: resistor; phosphor-bronze, silver pl; $2^{3}/_{32}$'' lg x ⅞'' wd x 1⅛'' h; 60 amp, 250 v; Kolten fuse clip #31–60, 250 v.	Mounts resistor	2Z2712.65
	COIL, relay: p/o Price Bros telephone relay #5803–1; 80 v DC; 2000 ohm DC resistance; 1'' diam x $1^{9}/_{16}$'' lg; Price Bros dwg #R–3721–N.	For bias interlock relay K–201.	3C1128–2
	COIL, relay: p/o Price Bros relay #3309–2; 200/240 v; 50/60 cyc, 270 ohm DC resistance; 1⅝'' lg x 1⅝'' wd x $1^{7}/_{16}$'' h; Price Bros dwg #R–2026S.	For filament relay K–202	3C1128–3
	COIL, relay: p/o Price Bros relay #3305–3; 200/240 v; 50/60 cyc, 380 ohm DC resistance; 1⅝'' lg x 1⅝'' wd x 1¼'' h; Price Bros dwg #R–2026–B.	For start-stop auxiliary control relay K–302.	3C1128–4
L–207	COIL, RF: ant matching; unshielded; 7½'' diam x 12'' lg; phenolic form, air core; 7 stud term on mica board parallel to lg dimen; Rad Receptor part #L207, dwg #D–2635–75.	Emergency antenna coupling	3C335–24
L–202	COIL, RF: choke unshielded; 10 mh at 150 kc, 2 amp, 4.3 ohms; 7'' OD x 18½'' lg phenolic form, air core; coil marked L–202; Rad Receptor dwg #D–2635–150.	V–201 plate choke	3C335–20
L–208	COIL, RF: choke; unshielded; 15 mh at 150 kc, 100 ma, 54 ohms; 5½'' OD x 17½'' lg; phenolic form, air core; coil marked L–208; Rad Receptor dwg #D–2635–125.	V–201 grid choke	3C335–21
L–203	COIL, RF: harmonic choke; unshielded; 7'' OD x 12'' lg; phenolic form, air core; 7 stud term on mica board parallel to lg dimen; coil marked L–203; Rad Receptor dwg #D–2635–100.	V–201 plate, harmonic suppressor.	3C335–22
L–209	COIL, RF: parasitic choke; unshielded; 6'' lg x 2'' ID; self-supporting; Rad Receptor dwg #B–2635–1.	V–201 grid, parasitic suppressor.	3C335–23
	CONTACT SET, relay: consists of one $^{5}/_{16}$'' diam cont on clip per Cramer RW dwg #A2–8 and two $^{5}/_{16}$'' diam cont on left-hand arm per Cramer RW dwg #B2–7; p/o Cramer RW time delay relay, type #TC–5M.	For blower delayed-release timing relay K–205.	2Z3196–33

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
	AMPLIFIER GROUP—Continued		
	CONTACT SET, relay: consists of 2 Price Bros cont arms #P–1126 ea w/one 3/8" diam cont; 2 Price Bros cont arms #P–1125 ea w/one 3/8" diam cont and 2 Price Bros cont bridges #P–861 ea w/two 3/8" diam cont; p/o Price Bros relay #3305–3	For start-stop auxiliary control relay K–302.	2Z3196–31
	CONTACT SET, relay: consists of 2 Price Bros cont arms #P–1126 ea w/one 3/8" diam cont; 2 Price Bros cont arms #P–1125 ea w/one 3/8" diam cont; 2 Price Bros cont arms #P–1026 ea w/one 3/8" diam cont and 3 Price Bros cont bridge #P–861 ea w/two 3/8" diam cont; p/o Price Bros relay #3309–2.	For filament relay K–202	2Z3196–32
	COUPLING, rigid: sleeve type; 1/4" shaft size ea end; 2" lg x 1/2" diam; brass, nickel pl; Rad Receptor dwg #A–431–334.	Shaft coupling	2Z3273–124
	COUPLING, rigid: split sleeve type; 9/16" shaft size at split end, 3/8" shaft size at other; 3 1/8" lg x 5/8" diam; stainless steel; incl compression sleeve ring; Rad Receptor dwg #B–431–333.	Shaft coupling	2Z3273–123
	KNOB: round; black bakelite; for 1/4" diam shaft; 1 5/8" diam x 3/4" h; Kurtz-Kasch #S–309–64–BBB.	Control knob	2Z5822–88
	KNOB: round; black bakelite; for 1/4" diam shaft; white indicator line marking; 3" diam x 15/16" h; Kurtz-Kasch #S–312–64–BBB–L.	Control knob	2Z5822–48
	KNOB: round; black bakelite; for 1/2" diam shaft; 4 1/2" diam x 1 3/8" h; Cont Diamond dwg #XK–1459 modified per Rad Receptor dwg #B–431–35.	Control knob	2Z5822–223
I–201, I–204	LAMP, incandescent: 120 v. 6 w; bulb S–6, clear; 1 7/8" lg overall; candelabra base; GE type # Mazda 6S6.	I–201—Filament pilot I–204—Grid bias pilot.	2Z5941
I–202, I–203	LAMP, incandescent; 120 v. 25 w; bulb T–10, inside frosted; 5 5/8" lg overall; med screw base; GE type # Mazda 25T10/1F.	Meter illumination	6Z6820–27
I–202, I–203	LAMPHOLDER: med screw; ceramic body; 2 11/32" lg x 1 5/8" wd x 1 5/8" h; Pass & Seymour #5401.	For meter illumination lamp	2Z5886–30
I–204	LIGHT, indicator: 1 1/8" diam amber jewel; for candelabra base, S–6 bulb; encl shell; brass shell; 1 3/32" diam x 2 7/8" lg; Dialco #31901 w/amber jewel.	For grid bias pilot lamp	2Z5884–16
I–201	LIGHT, indicator: 1 1/8" diam green jewel; candelabra base; brass shell; 1 3/32" diam x 2 7/8" lg; Dialco #31901 w/green jewel.	For filament pilot lamp	2Z5884–12
M–201	METER, ammeter: DC; JAN type MR35W200DCMA; range 0–200 ma; round molded phenolic flush mtg case; barrel 2.80" diam, 1.66" lg behind flange, round flange 3.5" diam; black numerals and pointer, white background; self-contained.	GRID CURRENT meter	3F902–1
M–202	METER, ammeter: DC; JAN type MR35W002DCAA; range 0–2 amp; round molded phenolic flush mtg case; barrel 2.80" diam, 1.66" lg behind flange, round flange 3.5" diam; calibrated for nonmagnetic panel; black numerals and pointer, white background; self-contained.	PLATE CURRENT meter	3F1002–21
M–203	METER, ammeter: RF; JAN type MR35W010RFAA; range 0–10 amp; round molded phenolic flush mtg case; barrel 2.80" diam, 1.66" lg behind flange, round flange 3.5" diam; calibrated for nonmagnetic panel; black numerals and pointer, white background; self-contained.	R. F. LINE CURRENT meter	3F1010–25

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
	AMPLIFIER GROUP—Continued		
M–204	METER, voltmeter: AC, 25 to 125 cyc; JAN type MR35W030ACVV; range 0–30 v; round molded phenolic flush mtg case; barrel 2.80″ diam, 1.66″ lg behind flange, round flange 3.5″ diam; calibrated for nonmagnetic panel; black numerals and pointer, white background; self-contained.	FILAMENT VOLTAGE meter.	3F8030–12
	MOTOR, self-synchronous: 2½″ lg x 2⅛″ wd x 1 11/16″ d; closed frame; timing motor w/gear trains; p/o Cramer RW type TC5M time delay relay; Haydon series 1600, ½ rpm, 230 v, 60 cyc, right rotation.	For blower delayed-release timing relay K–205.	3H3000S–10
L–205	REACTOR: filter choke; 10 hy; 450 ma; 65 ohm DC resistance; HS metal case; 6½″ lg x 5⅜″ wd x 6¼″ h; Freed Trans part/dwg #C–Z919–8, spec #XT–131A.	Bias supply filter	3C575X–3
K–205	RELAY, rotary: SPST; normally open; 10 amp 230 v AC cont; synchronous motor 230 v, 60 cps; 4½″ lg x 3″ wd x 2⅛″ d; 5 min time delay; Cramer RW type #TC–5M.	Blower delayed-release timing	2Z7587–191
K–201	RELAY, solenoid: SPST; normally open; 5 amp 200/240 v AC cont; coil single wound, 80 v DC, 0.040 amp operating current, 2000 ohm DC resistance, coil is ins; 2 7/16″ lg x 1⅞″ wd x 2¼″ d; Price Elec Corp type #5803–1.	Bias interlock	2Z7587–190
K–202	RELAY, solenoid: 2 pole, one SPST normally open and other SPDT; 20 amp, 230 v, AC cont; coil single wound, 200/240 v, 50/60 cps, 0.062 amp, 270 ohm DC resistance, coil is ins; 6⅝″ h x 4¾″ wd x 2¼″ d; Price Elec Corp type #3309–2 (front connected).	Filament relay	2Z7599A–44
K–203, K–204, K–206	RELAY, solenoid: DPST, normally open; 20 amp, 230 v AC cont; coil single wound, 220/240 v, 60 cps, 0.032 amp, 380 ohm DC resistance, coil is ins; 5½″ h x 4¾″ wd x 2¼″ d; Price Elec Corp type #3305–3 (front connected).	K–203—Blower relay K–204—Blower delayed-release relay. K–206—Bias supply primary relay.	2Z7590–181
R–220 thru R–227	RESISTOR, fixed: WW, noninductive; 1 ohm ±10%; 40 w at 315° C max; 4⅝″ lg x 1¼″ wd x ½″ h; WL plaque resistor, type #40P.	V–201 grid, current limiting	3Z4801–13
R–201, R–218	RESISTOR, fixed: WW; 20 ohms ±5% 140 w; 10 1/16″ lg x 1 1/16″ diam; ferrule term; JAN type RW10F200.	V–201 plate current limiting	3RW14111
R–217	RESISTOR, fixed: comp; 100 ohms ±10%; 8.5 w; 4″ lg x ¾″ diam; Globar ceramic type A.	V–201 grid, parasitic suppressor.	3Z6010–216
R–204 thru R–209, R–211 thru R–213	RESISTOR, fixed: WW; 500 ohms ±5%; 140 w at 275° C; 10 1/16″ lg x 1 1/16″ max diam; 2 ferrule term; JAN type RW10F501.	R–204 thru R–209—Bias supply bleeder. R–211 thru R–213—Current limiting resistors for high-voltage grounding switches S–203 and S–220.	3RW22529
R–216, R–219	RESISTOR, fixed: WW; 3100 ohms ±5% 18 w at 275° C; 2″ lg x 1 3/32″ diam; tab term; JAN type RW33G312.	R–216—I–201, filament pilot, dropping. R–219—I–204, grid bias pilot, dropping.	3RW27322
R–202, R–203	RESISTOR, fixed: ww; 3100 ohms ±5%; 50 w at 275° C; 4⅛″ lg x 1″ diam; 2 ferrule term 13/16″ lg x ½″ diam; JAN type RW13F312.	V–201 grid leak	3RW27302
R–210	RESISTOR, variable: ww; 250 ohms; 100 w; open case 3.19″ diam x 1.78″ d; JAN type RP251FK251LK.	Bias interlock relay K–201 adjustment.	3RP6307
X–201	SOCKET, tube: 1 cont tube mtg assem; round white glazed porcelain w/chromium pl copper ferrule at top and aluminum casting at bottom, 9¾″ diam x 8⅞″ h; Johnson EF#124–220–1 w/stud assem #H–124–220.	Socket for V–201	2Z8671.72

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
	AMPLIFIER GROUP—Continued		
X–202, X–203	SOCKET, tube: 4 cont; UX bayonet; steatite ceramic base, brass nickel pl shell; $2^{13}/_{16}$″ diam x 2″ h; Johnson EF part #209S.	X–202—Socket for V–202. X–203—Socket for V–203.	2Z8759.4
G–201 thru G–204	SPARKGAP ASSEMBLY: consists of 2 ball electrodes ½″ diam w/10–32 thd studs, base plate, and ins post: $3^1/_4$″ lg x $1^5/_8$″ wd x $5^5/_8$″ h; Rad Receptor dwg #C–431–141.	G–201—V–201 grid protection. G–202—V–201 plate protection. G–203—V–201 plate capacitor protection. G–204—V–201 load capacitor protection.	2Z8808–31
S–221	SWITCH, rotary: 1 pole, 6 position; steatite stator and rotor; 5″ h x $3^7/_8$″ wd x $3^3/_8$″ d; locking action, normally closed; Comm-Prod type 88S, 1 pole, 6 position, 1 sect.	EMERGENCY TUNING SWITCH.	3Z9825–12.24
S–201	SWITCH, rotary: 2 pole, 2 position; 2 sect; steatite stators and rotors; 5″ h x $3^7/_8$″ wd x $4^3/_4$″ d; shorting type contact; locking action, normally closed; Comm-Prod type 88S, 2 pole, 2 position, 2 sect.	M–203, R. F. LINE CURRENT meter, disconnect.	3Z9825–12.23
S–219	SWITCH, rotary: 2 pole, 3 position; 2 sect; steatite stators and rotors; $3^5/_{16}$″ h x $2^9/_{16}$″ wd x $3^5/_{16}$″ d; nonshorting contact; locking action, normally closed; Comm-Prod type 86S, 2 pole, 3 position, 2 sect.	Bias rectifier primary voltage adjustment.	3Z9825–12.22
S–205	SWITCH, rotary: 3 pole, 3 position; 3 sect; steatite stators and rotors; 5″ h x $3^7/_8$″ wd x $6^1/_8$″ d; locking action, normally closed; Comm-Prod type 88S, 3 pole, 3 position, 3 sect.	GRID FUNCTION SWITCH	3Z9825–12.25
S–210	SWITCH, rotary: 3 pole, 6 position; 3 sect; steatite stators and rotors; 5″ h x $3^7/_8$″ wd x $6^1/_8$″ d; locking action, normally closed; Comm-Prod type 88S, 3 pole, 6 position, 3 sect.	GRID TUNING SWITCH	3Z9825–12.26
	SWITCH, sensitive: SPST; 5 amp, 250 v; molded case; 2.406″ lg x 0.687″ wd x $1^5/_{16}$″ d overall; leaf spring actuator; JAN type SS04B20.	Switch.	3Z9558–39.10
S–208	SWITCH, sensitive: SPDT; 5 amp, 250 v; phenolic body; 2.437″ lg x 0.667″ wd x $1^3/_4$″ d overall; hinge leaf type; JAN type SS06B20.	Air interlock	3Z9558–39.9
S–204, S–216	SWITCH ASSEMBLY: door interlock; incl frame half and door half; 110/220 v DC, 10 amp; frame half $2^5/_{16}$″ lg x $1^1/_{16}$″ wd x $1^5/_{16}$″ h; door half $1^7/_8$″ lg x $1^1/_{16}$″ wd x $^5/_8$″ h; GE type #7460330–G4.	Door interlocks	3Z9560–7
S–203, S–220	CONTACT ASSEMBLY, switch: mechanical grounding; consists of mtg plate, movable cont, fixed cont mtd on $1^1/_4$″ diam x 4″ lg ins post; 10,000 v, 20 amp; $5^7/_{16}$″ lg x $3^5/_{16}$″ wd x $5^3/_8$″ h; Rad Receptor dwg #C–431–140.	High-voltage grounding	3Z1715–10.1
T–202	TRANSFORMER, power: filament type; input 200/220/240 v, 50/60 cyc, single ph; secd 2.55 v at 10 amp CT; HS metal case; $4^1/_4$″ lg x $3^3/_4$″ wd x $4^3/_4$″ h excl term; Freed Trans part/dwg #15109.	V–202, V–203 filament	2Z9600.139
T–204	TRANSFORMER, power: filament type; input 220 v, 50/60 cyc, single ph; secd 22.2 v at 60 amp CT; HS metal case; $10^1/_8$″ lg x $8^1/_8$″ wd x $8^1/_8$″ h excl term; Freed Trans part/dwg #15110.	V–201 filament	2Z9600.138
T–201	TRANSFORMER, power: plate type; input 200/220/240 v, 50/60 cyc, single ph; secd 3260 v at 450 ma CT; HS metal case; 6″ lg x 6″ wd x 9″ h excl term; Freed Trans part/dwg #15108.	Bias supply	2Z9601.83

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
	AMPLIFIER GROUP—Continued		
T–203	TRANSFORMER, variable power: input 115/230 v, 50/60 cyc, and 115 v, 25 cyc, single ph; output range w/230 v input is 0–270 v, 8 amp, 2.30 kva; output range w/115 v input is 0–270 v, 4 amp, 1.15 kva; output range w/115 v 25 cyc input is 0–135 v, 8 amp, 1.15 kva; varied by knob; open metal case; 7⅞″ diam x 4⅛″ h excl term; GR variac type V–20 HM.	V–201 filament voltage adjustment.	2Z9957–38
L–201	TRANSFORMER, variable RF: grid tuning variometer; unshielded; 7½″ diam x 20″ lg; phenolic form, air core; coil marked L–201; Rad Receptor part #L201, dwg #D–2635–175.	V–201 GRID TUNING	2Z962964
L–206	TRANSFORMER, variable RF: plate tuning variometer; unshielded; 14″ OD x 45″ lg; phenolic form, air core; coil marked L–206; Rad Receptor dwg #D–2635–200.	V–201 PLATE TUNING	2Z9629–61
V–202, V–203	TUBE, electron: JAN–866A/866; diode	Bias rectifiers	2J866A/866
V–201	TUBE, electron: JAN–891R triode	R-f power amplifier	2J891R
	ANTENNA TUNING GROUP		
C–401	CAPACITOR, fixed: mica 10,000 mmf ±10%; 1200 vdcw; 1 25/32″ lg x 1 1/32″ wd x 15/32″ h; molded case; JAN type CM55B103K.	ANT. CURRENT meter M–401 r-f bypass.	3K5510321
F–401	FUSE, wire: 7.5 amp; 0.046″ diam	Protects R. F. LINE CURRENT meter M–402.	1A407.5–1
I–401	LAMP, glow: 105/125 v, 1 w; bulb G–10 clear; med screw base; neon atmosphere; GE # Mazda NE30.	R. F. INDICATOR	2Z5890–8
I–401	LAMPHOLDER: porcelain body; med screw base; base 2 15/16″ lg x 2 23/32″ wd; Hubbell #9402.	For R. F. INDICATOR	6Z7803–1
M–402	METER, ammeter: RF; range 0–10 amp; round molded phenolic flush mtg case; barrel 2.80″ diam. 1.66″ lg behind flange, round flange 3.5″ diam; calibrated for nonmagnetic panel; black numerals and pointer, white background; self-contained; JAN type MR35W010RFAA.	R. F. LINE CURRENT	3F1010–25
M–401	METER, ammeter: RF; range 0–50 amp; round molded phenolic flush mtg case; barrel 2.80″ diam, 1.66″ lg behind flange, round flange 3.5″ diam; calibrated for nonmagnetic panel; black numerals and pointer, white background; ext Wemco #878654 thermocouple; JAN type MR35W050RFAA.	ANT. CURRENT	3F1050–30
G–402	SPARKGAP: wood base, metal electrode; 80,000 v ins; 11″ lg x 1⅞″ wd x 9½″ h; incl stand-off ins and corona shields; Rad Receptor dwg #C–431–625.	Protects against lightning	2Z8808–33
G–401	SPARKGAP ASSEMBLY: consists of 2 ball electrodes ½″ diam w/10–32 thd studs, base plate, and ins post; 3¼″ lg x 1⅝″ wd x 5⅝″ h; Rad Receptor dwg #C–431–141.	Transmission line protection	2Z8808–31
S–401	SWITCH, rotary: 2 pole, 2 position; uncased, micalex end plates, 12″ lg x 6″ wd x 5¼″ h overall; shorting type; p/o Army-Navy Amplifier Assembly AN/FRA–1; Johnson EF switch type 145–5 modified per Rad Receptor dwg #D–431–626.	ANT. CURRENT AMMETER switch; disconnects TC–401.	3Z9825–855
S–402	SWITCH, rotary: 2 pole, 2 position; 2 sect; steatite stators and rotors; 5″ h x 3⅞″ wd x 4¾″ d; shorting type contact; locking action, normally closed; Comm Prod type 88S, 2 pole, 2 position, 2 sect.	R. F. LINE AMMETER switch; disconnects meter M–402.	3Z9825–12.23

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
	ANTENNA TUNING GROUP—Continued		
TC–401	THERMOCOUPLE: 50 amp; rect plastic case; 7¼″ lg x 3″ wd x 2$\frac{1}{16}$″ h overall; calibrated per Wemco type #NT–35, style #1164407; 0–50 amp RF ammeter, and JAN type MR35WO50RFAA; Wemco style #878654.	Thermocouple for ANT. CURRANT meter M–401.	3F34528–250.2
L–401, L–403	TRANSFORMER, variable RF: ant coupling and tuning variometer; unshielded; 10″ diam x 20″ lg; phenolic form, air core; coil marked L–401, L–403; Rad Receptor part #L401, L403.	L–401—ANT. COUPLING L–403—ANT. TUNING.	2Z9629–62
L–402	TRANSFORMER, variable RF: ant loading variometer; unshielded; 24″ diam x 70″ lg; phenolic form, air core; coil marked L–402; Rad Receptor part #L402, dwg #D–2635–50.	Antenna loading	2Z9629–63
	MISCELLANEOUS GROUP		
	BOARD, terminal: 2 brass nickel pl term; molded phenolic block; 1⅞″ lg x 2⅛″ wd x 1½″ h; term point piece u/w 1 end piece and as many additional term point pieces as necessary for No. of term required, barrier between pieces; Wama Co term point piece type Add-A-Point.	For connections.	
	BOARD, terminal: 2 brass nickel pl term; molded phenolic block; 1$\frac{3}{16}$″ lg x 2⅛″ wd x 1½″ h; end piece, u/w as many term point pieces as necessary for No. of term required, barrier between pieces; Wama Co end piece type Add-A-Point.	For connections	
	CABLE ASSEMBLY, special purpose: JAN type WL4(19)14–8, WL4(19)14–1, and WL4(19)14–02, 1 ea used; 3 #14 AWG stranded cond, 19 strands ea cond; thermoplastic ins, color-coded; 600 v working; black vinylite sleeving overall; $\frac{7}{16}$″ OD; 3 Amphenol #31709 spade tongue wire term ea end; 20 ft lg excl term.	For connections	3E7350–1.240.1
	CLAMP: ground wire; cast bronze; 1 setscrew used; 1$\frac{9}{16}$″ lg x 1$\frac{1}{32}$″ wd x 1$\frac{5}{16}$″ h; for ⅝″ diam gnd rod and ¾″ diam stranded wire to #8 AWG solid wire; Hubbard Sprg #9492.	For earth ground	5B3392
	CLIP: resistor; phosphor-bronze, nickel pl; 1¾″ lg x ⅞″ wd x 1$\frac{7}{32}$″ h; 60 amp, 250 v; Kolten fuse clip #31–60 amp, 250 v.	Mounts resistor	2Z2712.63
	CLIP: resistor; phosphor-bronze, nickel pl; 1¾″ lg x 1$\frac{5}{32}$″ wd x 1⅜″ h; 60 amp, 600 v; Kolten fuse clip #31–60 amp, 600 v.	Mounts resistor	2Z2712.64
	INSULATOR, bowl: conical shape; white L5 grade glazed steatite; 2$\frac{25}{32}$″ h overall; 5¼″ diam; Genceraco #1088–00, steatite, #BN–2532.	For r-f insulation	3G1350–33
	INSULATOR, bushing: conical shape; white glazed steatite; ½″ lg; ⅞″ OD, 0.200″ ID; JAN type NS3W4203.	Insulator	3G3542–03
	INSULATOR, bushing: conical shape; white glazed steatite; ⅞″ lg; ⅞″ OD, shouldered to 1$\frac{5}{32}$″ diam, 0.200″ ID; JAN type NS3W4103.	Insulator	3G3541–03
	INSULATOR, bushing: conical shape; white glazed steatite; 1⅛″ lg; 1¾″ OD, 1$\frac{7}{64}$″ ID tapered to 1″ ID; JAN type NS3W4502.	Insulator	3G3545–02.1
	INSULATOR, feedthru: porcelain; consists of 2 Lapp #9166 insulators, ea 6⅜″ diam x 4⅜″ h; Lapp #9167.	Insulator	3G1350–97
	INSULATOR, spreader: round post shape; white glazed ceramic; 12½″ lg overall; 1″ diam, 3 grooves 6″ apart, ea ⅛″ wd x $\frac{1}{16}$″ d; Stupakoff spreader insulator, per Rad Receptor dwg #B431–610.	For transmission line	3G340–2

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
	MISCELLANEOUS GROUP—Continued		
	INSULATOR, standoff: ceramic; 1″ lg x ¾″ diam; AlSiMag #1010.	Insulator	3G1250–16.12
	INSULATOR, standoff: round post shape; white glazed steatite; 1″ lg x ¾″ diam; 10–32 thd hole ea end; JAN type NS3W0308.	Insulator	3G3503–08
	INSULATOR, standoff: round post shape; white glazed steatite; 1½″ lg x 1″ diam; ¼″–20 thd hole ea end; JAN type NS3W0412.	Insulator	3G3504–12
	INSULATOR, standoff: round post shape; white glazed steatite; 1½″ lg x 1⅛″ diam; ¼″–20 thd hole ea end; JAN type NS3W0512.	Insulator	3G3505–12
	INSULATOR, standoff: round post shape; white glazed steatite; 2″ lg x ¾″ diam; 10–32 thd hole ea end; JAN type NS3W0316.	Insulator	3G3503–16
	INSULATOR, standoff: round post shape; white glazed steatite; 2″ lg x 1¼″ diam; ¼″–20 thd hole ea end; JAN type NS3W0516.	Insulator	3G3505–16
	INSULATOR, standoff: round post shape; white glazed steatite; 4″ lg x 1¼″ diam; ¼″–20 thd hole ea end; JAN type NS3W0532.	Insulator	3G3505–32
	KNOB: round; black bakelite; for ¼″ diam shaft; white indicator line marking; 2$\frac{1}{16}$″ diam x ⅞″ h; Kurtz-Kasch #S–311–64–BBB–L.	Control	2Z5835
	KNOB: round; black bakelite; for ¼″ diam shaft; 7″ diam x 1¾″ h; Cont Diamond dwg #XK–2013 modified per Rad Receptor dwg #C–431–336.	Control	2Z5822–225
	ROD, ground: copperweld; 6″ lg x ⅝″ diam; Hubbard Sprg #9436.	For earth ground	5B4401–6
	SCREW, lag: sq hd; steel, copper pl; ⅜″ diam x 1½″ lg	Hardware	6L5106–1.5S
	SUPPORT, transmission line: steel; 14⅛″ lg x 13½″ wd x 1¼″ h; Rad Receptor dwg #D–431–618.	For transmission line	2Z9057–48
	TRANSMISSION LINE KIT: consists of three 360-ft lengths #10 solid copperweld wire, 35 spreaders, 15 line support and 16 ground rods; Rad Receptor dwg #D–431–609.	For transmission line	2Z10009–47
	WIRE, electrical: bare; one #14 AWG cond; copper, soft drawn; solid.	Wire	1A814.17
	WIRE, electrical: bare; one #10 AWG cond; copperweld, 40% conductivity, high-strength; solid.	Wire	1A810.21
	WIRE, electrical: bare; one #6 AWG cond; copperweld, 40% conductivity, high-strength; solid.	Wire	1A806.14
	WRENCH: Allen head setscrew; 3¼″ lg x 1⅛″ wd x ¼″ hex stock; alloy steel, cad pl; L shape; for ½″ and $\frac{9}{16}$″ socket setscrew; Allen Mfg #¼″.	Tool	6L57400–3
	RECTIFIER GROUP		
B–301	BLOWER: centrifugal vane; electric motor operated; 36 blades, 7$\frac{29}{32}$″ diam; guarded; 13⅜″ h x 14⅝″ wd x 17⅜″ d; 1200 cfm displacement at 1725 rpm, 1000 cfm displacement at 1435 rpm; direct drive; black wrinkle steel housing; Rotron model A, type B–703, dwg #S47090.	General ventilation	6Z995
C–301	CAPACITOR, fixed: paper dielectric; JAN type CP70D1DT205K; 2 mf ± 10%; 12,500 vdcw; HS metal case; 12⅞″ lg x 13½″ wd x 5⅛″ h.	High-voltage filter	3DB2–170

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
	RECTIFIER GROUP—Continued		
S–301	CIRCUIT BREAKER: magnetic and thermal; 3 pole; 250 v, 50/60 cyc, 90 amp; molded bakelite case; 10″ lg x 6″ wd x 4¾″ d; time delay action; manual reset; I–T–E type ET–1980.	MAIN LINE circuit breaker	3H900–90–1
S–302	CIRCUIT BREAKER: thermal; 2 pole; 125/250 v AC/DC, 15 amp; phenolic case; 6″ lg x 3″ wd x 3 31/32″ h; time delay action, 20 to 30 sec for 200% overload; manual reset; I–T–E type ET–1230, front connection.	FILAMENT circuit breaker	3H900–15–40
	CLEANER, air: panel type; steel contr; 30⅜″ lg x 30⅜″ wd x ¾″ thk; Air-Maze type R–82S, galv.	Air cleaner	
	COIL, relay: p/o Federal Elec Prod AC magnetic contactor #31163; 200/240 v, 50 cyc, 8.3 ohm DC resistance; 3¼″ x 2¾″ wd x 2 7/16″ h; Federal Elec Prod #CB307.	For plate primary relay K–305	3C1135–1
	COIL, relay: p/o Federal Elec Prod AC magnetic contactor #31163; 200/240 v, 60 cyc, 5.7 ohm DC resistance; 3″ lg x 2 1 1/16″ wd x 2 7/16″ h; Federal Elec Prod #CB306.	For plate primary relay K–305	3C1135
	COIL, relay: p/o Price Bros telephone relay #5806–4; 6 v DC, 50 ohm DC resistance; 1″ diam x 1 1/16″ lg; Price Bros dwg #R–3721–L.	For plate overload relay K–307	3C1128
	COIL, relay: p/o Price Bros relay #3305–3; 200/240 v, 50/60 cyc, 380 ohm DC resistance; 1⅝″ lg x 1⅝″ wd x 1¼″ h; Price Bros dwg #R–2026–F	For start-stop auxiliary control relay K–302.	3C1128–4
	COIL, relay: p/o Price Bros high-voltage relay #3647–4; 200/240 v, 50/60 cyc, 125 ohm DC resistance; 2″ lg x 1⅝″ wd x 1 5/16″ h; Price Bros dwg #R–1420–C.	For filter capacitor charging relay K–306.	3C1128–1
	CONTACT SET, relay: consists of 1 Cramer RW clip per dwg #A2–10 w/one 5/16″ diam cont, and 1 Cramer RW left-hand arm per dwg #B2–7 w/one 5/16″ diam cont; p/o Cramer RW time delay relay type TC–60S.	For plate time delay relay K–304.	2Z3196–36
	CONTACT SET, relay: consists of 2 Cramer RW clip per dwg #A2–10 ea w/one 5/16″ diam cont, 2 Cramer RW arm per dwg #B2–7 ea w/one 5/16″ diam cont, one arm left hand and one right hand; p/o Cramer RW time delay relay type TC–45S.	For start-stop control relay K–301.	2Z3196–37
	CONTACT SET, relay: consists of 3 Federal Elec Prod strap #31166 ea w/two 1 1/16″ diam cont, 3 Federal Elec Prod bracket #31165 ea w/one 1 1/16″ cont, 3 Federal Elec Prod bracket #31164 ea w/one 1 1/16″ diam cont, and one Federal Elec Prod block assembly #31167; p/o Federal Elec Prod AC contactor #31163–06.	For plate relay K–305	2Z3196–35
	CONTACT SET, relay: consists of one ⅜″ diam cont on left cont bracket, Price Bros #P–2786–L; one ⅜″ diam cont on right cont bracket, Price Bros #P–2786–R; two ⅜″ diam cont on cont bridge, Price Bros #P–1050; p/o Price Bros relay #3647–4.	For filter capacitor charging relay K–306.	2Z3196–34
	CONTACT SET, relay: consists of 2 Price Bros cont arms #P–1126 ea w/one ⅜″ diam cont, 2 Price Bros cont arms #P–1125 ea w/one ⅜″ diam cont and 2 Price Bros cont bridges #P–861 ea w/two ⅜″ diam cont; p/o Price Bros relay #3305–3.	For start-stop auxiliary control relay K–302.	2Z3196–31
	COUPLING, rigid: sleeve type; ¼″ shaft size ea end; 2″ lg x ½″ diam; brass, nickel pl; Rad Receptor dwg #A–431–334.	COUPLES shafts	2Z3273–124
	KNOB: round; black bakelite; for ⅜″ diam shaft; 4½″ diam x 1⅜″ h; Cont Diamond dwg #XK–1459 modified per Rad Receptor dwg #B–431–342.	Control	2Z5822–224

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
	RECTIFIER GROUP—Continued		
I–301, I–302	LAMP, incandescent: 120 v, 6 w; bulb S–6, clear; 1⅞″ lg overall; candelabra base; GE type #Mazda 6S6.	I–301—PLATE pilot lamp. I–302—FILAMENT pilot lamp.	2Z5941
I–303, I–304	LAMP, incandescent: 120 v, 25 w; bulb T–10, inside frosted; 5⅝″ lg overall; medium screw base; GE type #Mazda 25T10/1F.	I–303 and I–304—Meter illumination.	6Z6820–27
I–303, I–304	LAMPHOLDER: medium screw; ceramic body; 2 11/32″ lg x 1⅝″ wd x 1⅝″ h; Pass & Seymour #5401.	For meter illumination lamps	2Z5886–30
I–302	LIGHT, indicator: 1⅛″ diam green jewel; for candelabra base, S–6 bulb; brass shell; 1 3/32″ diam x 2⅞″ lg; Dialco #31901 w/green jewel.	I–302—For FILAMENT pilot lamp.	2Z5884–12
I–301	LIGHT, indicator: 1⅛″ diam red jewel; for candelabra base, S–6 bulb; brass shell; 1 3/32″ diam x 2⅞″ lg; Dialco #31901 w/red jewel.	For PLATE pilot lamp	2Z5884–13
M–302	METER, time: elapsed time indicator; direct reading; automatic start and stop; 3⅜″ lg overall x 2 13/16″ diam case; 0 to 9999.9 hrs, 5 rotating drum counters, ea calibrated; operates from 230 v, 60 cps line; round flush mtg black molded phenolic case; Cramer RW type E2.	FILAMENT HRS meter	3F9090
M–303, M–304	METER, voltmeter: AC, 25 to 125 cyc; JAN type MR35W300ACVV; range 0 to 300 v; round molded phenolic flush mtg case; barrel 2.80″ diam, 1.66″ d behind flange, round flange 3.5″ diam; calibrated for nonmagnetic panel; black numerals and pointer, white background; self-contained.	M–303—FIL. PRIMARY voltmeter. M–304—LINE VOLTAGE meter.	3F8300–5
M–301	METER, voltmeter: DC; JAN type MR35W015DCKV; range 0–15 kv; round molded phenolic flush mtg case; barrel 2.80″ diam, 1.66″ d behind flange, round flange 3.5″ diam; 1000 ohms per volt; calibrated for nonmagnetic panel; black numerals and pointer, white background; external multipliers.	PLATE VOLTAGE meter	3F13999–1.6
	MOTOR, self-synchronous: 230 v, 60 cyc, single ph; 2½″ lg x 2⅛″ wd x 1 3/16″ d; closed frame; timing motor w/gear trains; p/o Cramer RW type TC60S time delay relay set for 45 sec; Haydon series 1600, ⅕ rpm, 230 v, 60 cyc, right rotation.	For plate time delay relay K–304.	3H3000S–34
	MOTOR, self-synchronous: 230 v, 60 cyc, single ph; 2½″ lg x 2⅛″ wd x 1 3/16″ d; closed frame; timing motor w/gear trains; p/o Cramer RW type TC45S time delay relay; Haydon series 1600, 1 rpm, 230 v, 60 cyc, right rotation.	For start-stop control relay K–301.	3H3000S–107
	MOUNT, vibration: square mtg; 1¾″ lg x 1¾″ wd x ⅝″ h over all; rubber cushion, plate form, 1½″ diam x ⅝″ thk; steel sleeve w/0.257″ bolt hole; Lord type 150P12.	Shock mounting	2Z8502–1
L–301	REACTOR: swinging choke; 0.3 to 1.7 hy, 2 to 0.2 amp; 5 ohm DC resistance; HS metal case, 9½″ diam x 20¾″ h; Harrison Engineering Corp dwg #367, spec #667.	High-voltage filter	3C323–186A
K–304	RELAY, rotary: SPST; normally open; 10 amp, 230 v AC cont; synchronous motor, 230 v, 60 cyc; 4½″ lg x 3″ wd x 2⅛″ d; 45 sec time delay; Cramer RW type TC–60S.	Plate time delay relay	2Z7587–192
K–301	RELAY, rotary: DPST; normally open; 10 amp, 230 v AC cont; synchronous motor, 230 v, 60 cps; 4½″ lg x 3″ wd x 2⅛″ d; ckt 1 closes in 11½ sec, ckt 2 closes in 1 to 1½ sec and opens after 1 to 1½ sec; Cramer RW type TC–45S.	Start-stop control relay	2Z7590–180

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
	RECTIFIER GROUP—Continued		
K–306	RELAY, solenoid: SPST; normally open; 20 amp, 230 v AC cont; coil single wound, 220/240 v 50/60 cps, 0.068 amp, 125 ohm DC resistance, coil is insulated; 7½″ lg x 4½″ wd x 3¾″ d; Price Elec Corp type 3647–4.	Filter capacitor changing relay.	2Z7587–193
K–307	RELAY, solenoid: DPST; normally closed; 5 amp, 200/240 v AC cont; coil single wound, 6 v DC, 0.120 amp operating current, 0.060 releasing current, 50 ohm DC resistance, coil is insulated; 2$^{7}/_{16}$″ lg x 1⅞″ wd x 2¼″ d; Price Elec Corp type 5806–4.	Plate overload relay	2Z7590–179
K–302 K–303	RELAY, solenoid: DPST; normally open; 20 amp, 230 v AC cont; coil single wound, 220/240 v, 60 cps, 0.032 amp, 380 ohm DC resistance, coil is insulated; 5½″ h x 4¾″ wd x 2¼″ d; Price Electric Corp type 3305–3 (front connected).	K–302—Start-stop auxiliary control relay. K–303—Filament relay.	2Z7590–181
K–305	RELAY, solenoid: 4PST; normally open; 100 amp, 220 v AC cont; coil single wound, 220 v, 60 cps, 0.58 amp, 5.7 ohm DC resistance, coil is insulated; 12$^{9}/_{16}$″ lg x 7½″ wd x 5¼″ d; Federal Elec Prod type 31163–06.	Plate primary relay	2Z7593–122
R–329 thru R–331	RESISTOR, fixed: WW; 500 ohms ±5%; 140 w at 275° C; 10$^{7}/_{16}$″ lg x 1$^{5}/_{16}$″ max diam; 2 ferrule term; JAN type RW10F501.	Current limiting resistors for high-voltage grounding.	3RW22529
R–340	RESISTOR, fixed: WW; 10,000 ohms ±5%; 40 w at 275° C; 3$^{7}/_{16}$″ lg x 1$^{1}/_{16}$″ max diam; 2 ferrule term 1$^{3}/_{16}$″ diam x ½″ lg; JAN type RW14F103.	Protects PLATE VOLTAGE meter M–301.	3RW30304
R–301 thru R–303 R–306 thru R–328	RESISTOR, fixed: WW; 2,000 ohms ±5%; 140 w; 10$^{7}/_{16}$″ lg x 1$^{15}/_{16}$″ max diam; ferrule term; JAN type RW10F-202.	R–301 thru R–303—Filter capacitor charging. R–306 thru R–328—High-voltage bleeders.	3RW26122
R–336, R–337	RESISTOR, fixed: WW; 3100 ohms ±5%; 18 w at 275° C; 3″ lg x $^{19}/_{32}$″ max diam; tab term; JAN type RW33G312.	R–336—Dropping resistor for PLATE indicator lamp I–301. R–337—Dropping resistor for FILAMENT indicator lamp I–302.	3RW27322
R–334, R–338, R–339	RESISTOR, fixed: WW; JAN type MFA505; 5 meg ±0.5%; 5.0 kv rating; 9$^{25}/_{32}$″ lg x 1$^{5}/_{16}$″ diam.	R–334, R–338, and R–339—Multiplier for PLATE VOLTAGE meter M–301.	3RM500–1
R–335	RESISTOR, variable: WW; 5 ohms; 100 w; open case, 3.19″ diam x 1.78″ d; JAN type RP251FK5ROLK.	R–335—Adjustment for plate overload relay K–307.	3RP1806
X–301 thru X–306	SOCKET, tube: 4 cont, 50 w bayonet base; above chassis mtg; round white porcelain glazed base w/aluminum shell, 3⅜″ diam x 2$^{3}/_{32}$″ overall; Johnson EF #123–211B modified per Rad Receptor dwg #B–431–341.	X–301—Socket for V–301 X–302—Socket for V–302. X–303—Socket for V–303. X–304—Socket for V–304. X–305—Socket for V–305. X–306—Socket for V–306.	2Z8674.148
G–301	SPARKGAP ASSEMBLY: consists of 2 ball electrodes ½″ diam with ¼″ diam rod and 2 blocks; 2½″ lg x 1″ wd x ½″ h; distance between balls adj by Allen head setscrew; Harrison Engineering Corp dwg #385.	Protects filter reactor L–301	2Z8808–32
S–310	SWITCH, rotary: 2 pole, 3 position; 2 sect; steatite stators and rotors; 3$^{5}/_{16}$″ h x 2$^{9}/_{16}$″ wd x 3$^{5}/_{16}$″; nonshorting cont; locking action, normally closed; Comm-Prod type 86S,2 pole, 3 position, 2 sect.	LINE VOLTAGE metering switch.	3Z9825–12.22
S–305	SWITCH, rotary: 3 pole, 2 position; 6 sect; 100 amp, 500 v AC, 250 v DC; phenolic case; 6¾″ sq x 8$^{7}/_{32}$″ d; Ahlers type II, dwg #9017.	HIGH-LOW PLATE VOLTAGE switch.	3Z9825–40.13

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
	RECTIFIER GROUP—Continued		
S–303	SWITCH, rotary: 3 pole, 4 position; 6 sect; 100 amp, 500 v AC, 250 v DC; phenolic case; 6¾″ x 8$^{7}/_{32}$″ d; Ahlers type II, dwg #9016.	PRI. VOLTAGE ADJ. switch	3Z9825–40.14
	SWITCH, sensitive: SPST; JAN #SS04B20; 5 amp, 250 v; molded case; 2.406″ lg x 0.687″ wd x 1$^{5}/_{16}$″ d overall; leaf spring actuator.	Switch	3Z9558–39.10
S–309, S–312	SWITCH ASSEMBLY: mechanical grounding; consists of mtg plate, movable cont, fixed cont mtd on 1¼″ diam x 4″ lg ins post; 10,000 v, 20 amp; 5$^{7}/_{16}$″ lg x 3$^{5}/_{16}$″ wd w 5⅜″ h; Rad Receptor dwg #C–431–140.	S–309, S–312—High-voltage grounding.	3Z1715–10.1
S–307, S–311	SWITCH ASSEMBLY: door interlock; incl frame half and door half; 110/220 v DC, 10 amp; frame half 2$^{5}/_{16}$″ lg x 1$^{1}/_{16}$″ wd x 1$^{5}/_{16}$″ h; door half 1⅞″ lg x 1$^{1}/_{16}$″ wd x ⅝″ h; GE type #7460330–G4.	S–307, S–311—Door interlocks.	3Z9560–7
T–304 thru T–306	TRANSFORMER, power: filament type; input 220 v, 50/60 cyc single ph; secd 5 v at 10 amp CT; HS metal case; 5¼″ lg x 5⅛″ wd x 6″ h excl term; Freed Trans part/dwg #15106.	T–304—Filament transformer for V–301. T–305—Filament transformer for V–302. T–306—Filament transformer for V–303.	2Z9600.137
T–307	TRANSFORMER, power: filament type; input 220 v, 50/60 cyc, single ph; secd 5.1 v at 30 amp; HS metal case; Freed Trans part/dwg #15107.	Filament transformer for V–304, V–305, and V–306.	2Z9600.136
T–301 thru T–303	TRANSFORMER, power: plate type; input 200/220/240 v, 50/60 cyc, single ph; secd 3920 v at 1.63 amp; HS metal case; 17″ diam x 28″ h excl term; Harrison Engineering Corp dwg #366, spec #XT–119B.	T–301 thru T–303—Plate power.	2Z9601.82
T–308	TRANSFORMER, variable power: input 115/230 v, 50/60 cyc and 115 v 25 cyc single ph; output range w/230 v input is 0–270 v, 2 amp, 0.58 kva; output range w/115 v input is 0–270 v, 1 amp, 0.29 kva; output range w/115 v, 25 cyc input is 0–135 v, 2 amp, 0.29 kva; varied by knob; open metal case; 4$^{13}/_{16}$″ diam x 3$^{21}/_{32}$″ h excl term; GR Variac type V–5H.	Rectifier filament voltage control.	2Z9957–37
V–301 thru V–306	TUBE, electron: JAN–575A diode	V–301 thru V–306—High-voltage rectifier tubes.	2J575A

TM 11-5028-2

SIGNAL CORPS

13 JAN 57

PUBLICATION AMPLIFIER ASSEMBLIES: MDLS: AN/FRA-1A, AN/FRA-1B MAINTENANCE MANUAL DTD 10 NOV 48			CHARGE OUT RECORD CARD
DATE ISSUED	SIGNATURE OF RECIPIENT	DIVISION SECTION OR OFFICE	DATE RETURNED

EMC 330 (1 NOV 54)

PUBLICATION	CHARGE OUT RECORD CARD

DATE ISSUED	SIGNATURE OF RECIPIENT	DIVISION SECTION OR OFFICE	DATE RETURNED

EMC 330 (1 NOV 54)

TM11-5028-2